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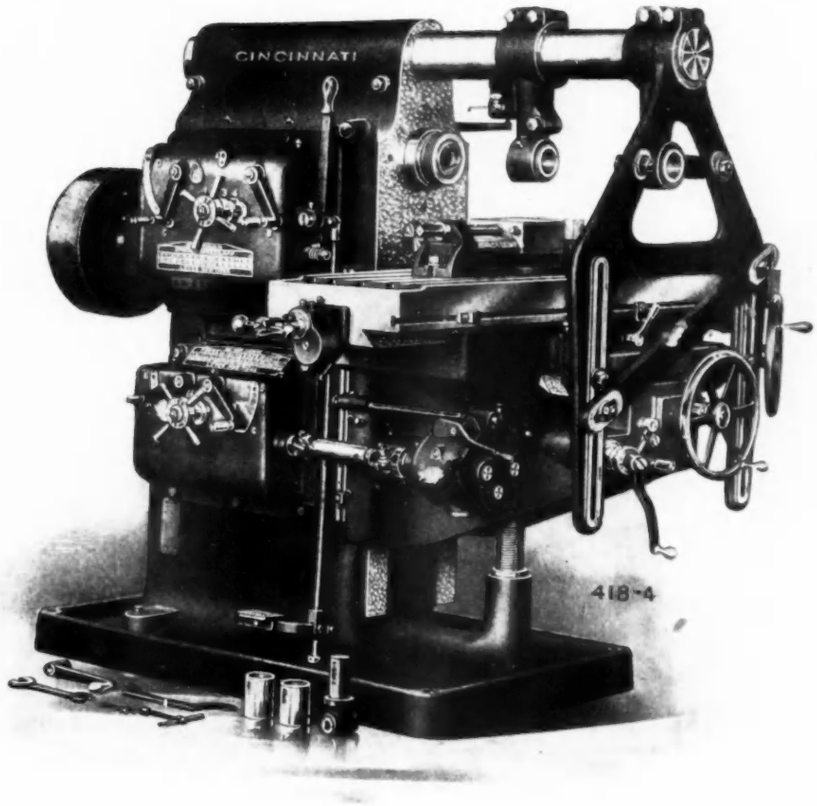


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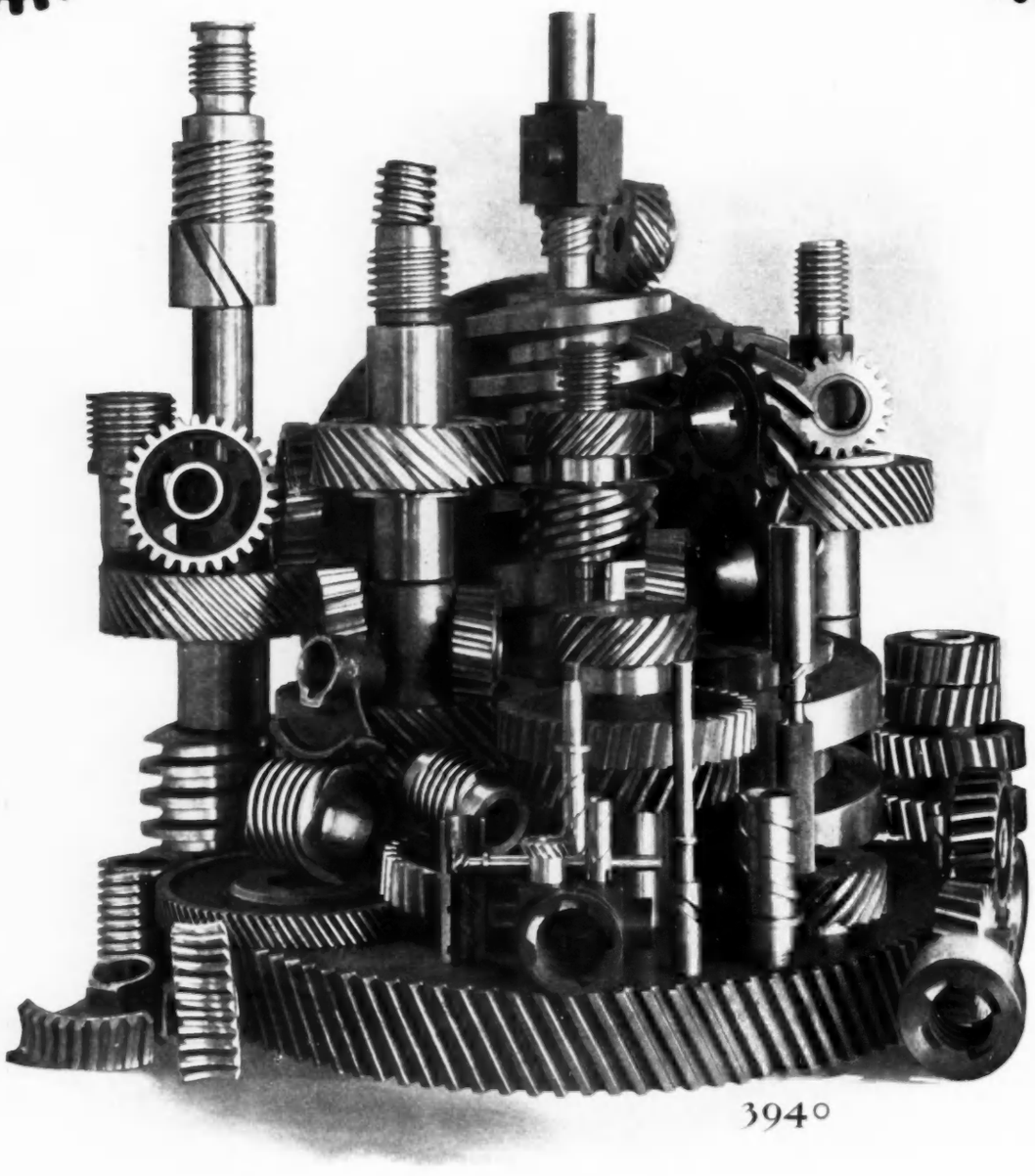


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# Rigidity Test of a 24 x 24-inch x 8-foot Planer

## Careful Observations of All Essential Parts Showed That under Heavy Cuts Some Deflected, Others Did Not—A Creditable Performance

BY JAMES A. PRATT

There are two features about the modern machine tool using high-speed cutters, which are generally recognized by manufacturers: 1. The machine is relatively short lived. 2. The high-speed steel tools can take much heavier cuts than the machine will sustain. Recognizing these facts, it was thought that a test, of the nature to be outlined in this paper, might bring out some information which would be of value in pointing the way to an improvement in design.

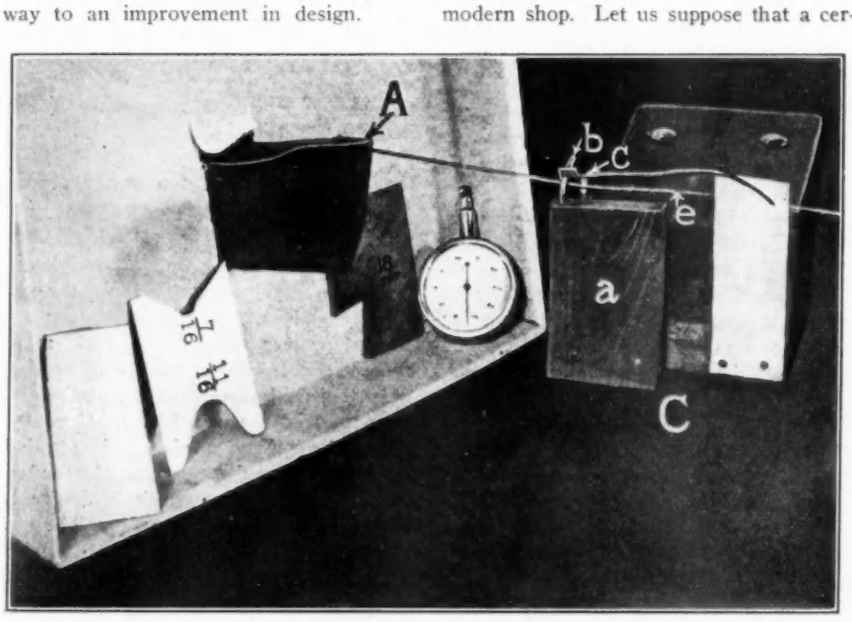


FIG. 1. THE CUTTING TOOL, ITS TEMPLETS, AN "AMES" DIAL GAGE AND THE PLATEN INSTRUMENT

### Some Observations

If one watches a large machine tool running on a heavy cut and using a high-speed steel cutting tool, he will notice a considerable amount of jar, or chatter; since this chatter is caused either by looseness at the joints of the elements composing the machine, or by the spring of the material in the elements themselves, we may say, quite logically, that if we could get an ideally rigid machine, we might do away with *all chatter*, at least so far as the machine is concerned. So, as long as there is any chatter, some part of the apparatus, either the machine or the work, is springing.

In this test the work was clamped as solidly as possible to the platen; beyond a doubt, however, the work sprung to some extent. Since we were concerned with the amount of spring in the machine we did not attempt to take any measurements of the movement of the work. If, however, we had gone over each part of the machine and found no deflections at any point, and there was still chatter under cut, we would know that the spring was in the work and that the clamping was not rigid enough.

Since we have considerable evidence of spring in various machine tools, a little thought will make it clear that such spring is a considerable factor in shortening the life of the tool as a useful unit in the modern shop. Let us suppose that a certain shaft in a planer springs 0.001 inch at each stroke of the machine, and that this is repeated many times in the working day; will not the various elements connected with this shaft, and the shaft itself, be much shorter lived than they would be if all related parts in this section were perfectly solid? This is assuming a simple deflection of the shaft, where this element is displaced from a normal position, upon the application of a load and returns to its original position when the load is relieved. Where many elements spring, as outlined above, the racking action on any structure is very severe; clearly, the useful life of any sort of structure will be shortened by such a process; by just how much we cannot say, because it is probable that few, if any, of the standard machine tools on the market have yet been brought to the point where they do not spring, to some extent at least, under cuts of ordinary proportions with modern high-speed steel tools.

One thing is certain, if we could get a machine which was perfectly rigid under all practical conditions, the production end of the machine shop would show better results.

### Material Used in the Test

The material used for the test was a good grade of gray iron, such as is commonly found in machinery castings in the shop; no special mixture was made; the aim was to get as near to commercial conditions as possible. The form of these castings is shown in Fig. 3 to be rectangular plates; three were used, thus giving two breaks in the cut, which were of advantage for purposes of observation.

### The Cutting Tool

This tool was made of Novo self-hardening steel, furnished by Messrs. Hermann Boker & Co., 101 Duane street, New York City. The size of stock was 1x2 inches. The cutting speed was 25 feet per minute. This is a very conservative cutting speed, not anywhere near up to the limit of the tool, still the heat generated was great enough to turn the tool blue for ¼ inch back from the cutting edge. The tool was ground but three times, once immediately after forging, and twice to produce a proper cutting edge after dulling. An attempt has been made to show the condition of the cutting edge of the tool in Fig. 1 at *A*. It hardly does the tool justice, however, as the edge was in much better shape than would appear from the cut. In treating the tool the standard method, as per directions furnished by the Boker Company, was followed.

### Form of the Cutting Tool

The form of the tool was the Taylor form for cast iron. The adoption of this type gave a tool of standard shape and angles, one that is well known, and is used, either exactly or approximately, by many shops throughout the country. The angles and curves were very carefully formed to templets, and when sharpening care was taken to maintain these forms. Thus each successive test was run with exactly the same form of tool. The angles, etc., are shown in Fig. 2, which follows the requirements as presented by Mr. Taylor before the American Society of Mechanical Engineers. This tool takes a heavy cut in a remarkably free manner.

### The Indicating Instruments

These instruments were dial gages, furnished by the B. C. Ames Manufacturing Company, of Waltham, Mass. One of them, together with the cutting tool and templets, is shown in Fig. 1. The calibration report of Mr. Gribben, presented in an accompanying article, shows them to be extremely accurate, especially when we consider the fact that these were stock instruments, obtained directly from the manufacturer without any consideration whatsoever of the purpose for which they were to be used.

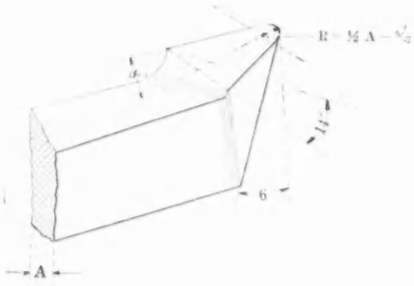


FIG. 2. ANGLES OF TAYLOR TOOL FOR CAST IRON

The instrument for testing the deflection of the platen was a home-made affair, a rather crude form of deflectometer. This is also shown in Fig. 1 at *C*, where the details of construction are fairly clear. The base is of 1x4x6-inch stock; the upright *a* supports the needle fulcrum *b* and post *c*. This post sets in a hole drilled in the upright and can slide freely up and down. The top of post *a* is cut in a V-form, and in this V the indicating needle rests. A notch is cut in the post so that it can rest on the steel wire *e*. This steel wire is the fixed element supported entirely separate from the machine. By this means we can measure any deflection of the platen, provided it is not too great. The movement of the needle over the scale *f* is caused by the instrument varying its position relative to the line *e*, and knowing the ratio of the whole length of the needle, to the distance between fulcrum *b* and post *c*, we may calculate the exact deflection of the platen. It will be seen that the wire *e* will have to sustain only the weight of the needle, which was very small. This needle was made of thin sheet metal.

### Method of Attaching

All of the Ames instruments were so placed that the fingers rested against the wire, or part of the machine, relative to which it was desired to get the deflection of another machine part. Fig. 3 shows the machine as a whole with the upright at *B* and *C* for holding the steel wires from which the normal position readings were taken. The Ames instrument for reading the deflection of the housings, that is, the amount they tipped back, can be seen at *X*. The instrument for reading the deflection of the rear of the platen is shown attached at *Y*. A similar instrument was located at the head end of the platen. The simple movement of the needle of the Ames instrument indicated the deflection in thousandths of an inch. The method of determining deflection by the platen instrument has already been explained. The post mentioned in the description of the platen instrument, simply slid along on the wire *A*, Fig. 3. Under no load the needle gave the reading due to the sag of the wire. If this was the same under a load (or cut) it was proof that the platen did not deflect; if different, it indicated that the platen did deflect.

### Method of Supporting the Lines

The method of measuring the deflection of the housings from an upright position, and of the platen from a horizontal one, was to have the instrument finger bear on a tightly drawn steel wire. This wire

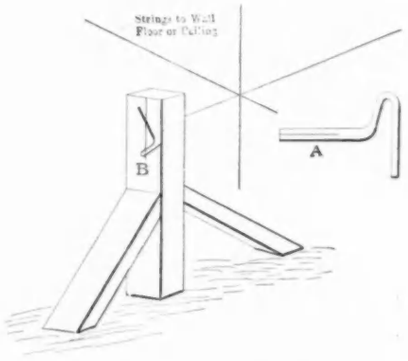


FIG. 4. KEY AND METHOD OF CONNECTING PIANO WIRE REFERENCE LINES

was supported by means of uprights as shown in Fig. 3, where one of the supports for the platen wire is shown at *B* and those for the housing face at *C*. These supports were nailed up of 2x4-inch stuff. A method of drawing a wire thus supported is shown in Fig. 4. Here *A* is a key bent from a piece of 3/16-inch round steel, and slotted at the end so that the piano wire which is used as a line will pass through the slot. The wire in this work was 0.015 inches in diam-

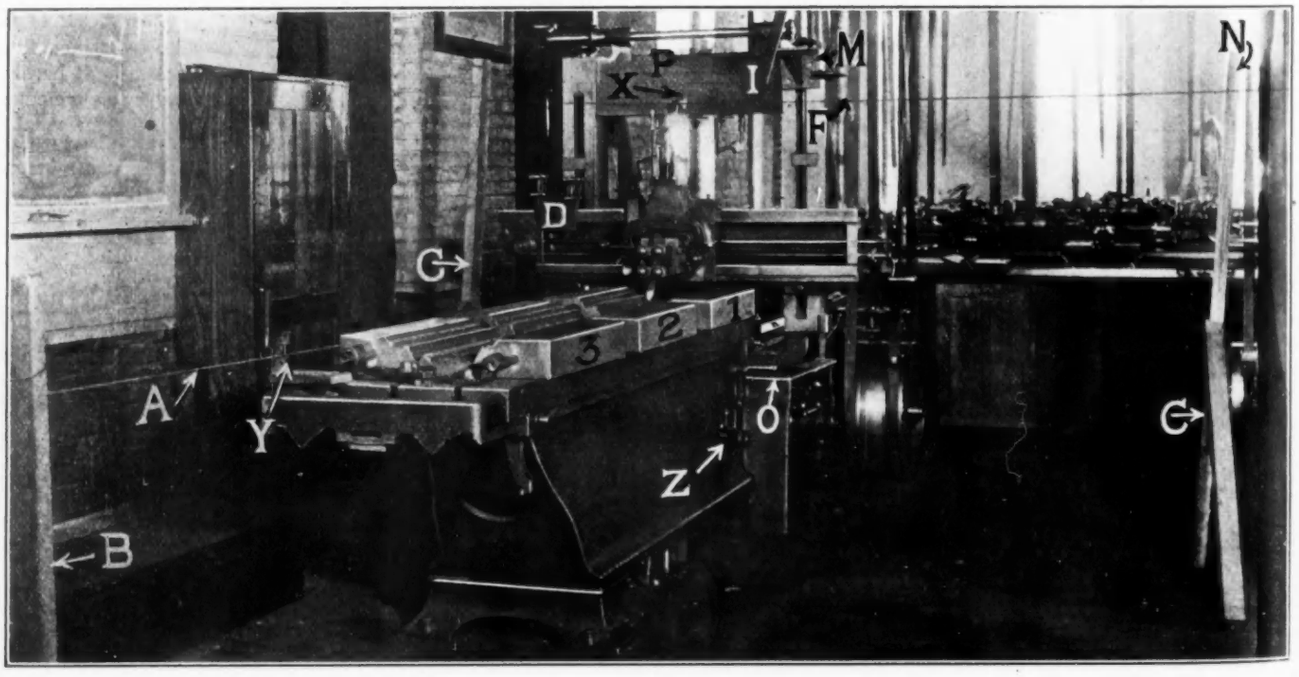


FIG. 3. GENERAL VIEW OF PLANER AND POSITION OF LINE SUPPORTS

eter, and passed into the slot in the upright, the key being turned, as shown at *B*, to maintain the tension.

To "position" the wire, lines are run off perpendicular to it and fastened with nails in the floor or wall. Thus the line may be moved up or down, to right or left, at will. This arrangement at each end of a line makes a very satisfactory adjustment.

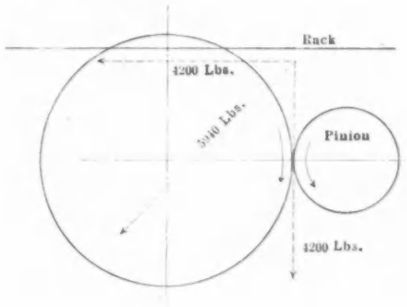


FIG. 6. DIAGRAM OF FORCES AT BULL WHEEL

### INSTRUMENT FOR TESTING CROSS-RAIL SCREW

This instrument is shown in Fig. 5. It was the most accurate piece of apparatus made, hence most expensive. It gave no results, because there were none to get. It was made up of a knee, to the face of which was screwed a parallel strip *A*. Through the face of this knee ran a carefully fitted shaft, with an eccentric section as shown at *B*. On the end of this shaft was fitted a pulley *C*. From this pulley two cords were run, one to the head (traveling head on the cross rail) and the other to the weight *D*. The cord running to the head was so placed that it lay in the plane of the center line of the cross-feed screw. While Fig. 5 shows details of the instrument to advantage, Fig. 3 gives a better perspective; here it can be seen attached to the cross rail at *D*.

### METHOD OF OPERATING MACHINE FOR TEST

This was to run the machine one stroke *without* the cut and follow by a stroke *with* the cut. The difference in readings between *no cut* and *cut* was taken as the deflection of the machine due to the cut.

### THE PLANER

The machine selected for testing was a 24-inch by 24-inch by 8-foot, belt driven, single-head planer. The machine had been used but little and abused none. When the rigorous work put upon it in the test is considered, it must be admitted that it showed itself to be an excellent piece of present-day machine design. Before starting the test, all gibs were set up closely, and a chip was taken off the platen.

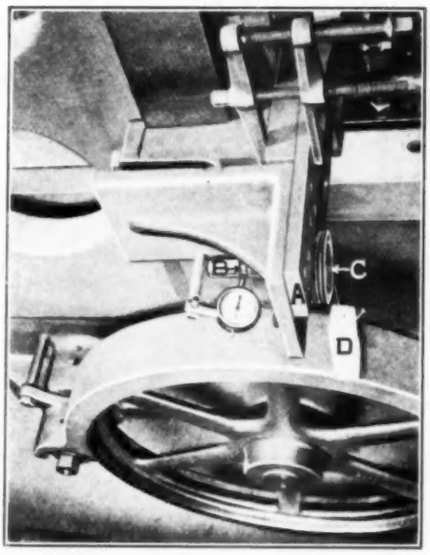


FIG. 5. INSTRUMENT FOR TESTING CROSS-FEED SCREW

Details of the various dimensions of the machine will be given only in such places as may appear necessary, in order to get a better understanding of the results of the test. Beyond this they would be of no value, as the cuts show the general proportions satisfactorily. No attempt was made at a physical test, practical results were the features sought; no deflection of 0.00025 inch or less was considered; if a part showed only 0.00025 inch deflection, it was considered as rigid enough. Eight different tests were run on as many different days, and the deflections given are the average results of these eight tests.

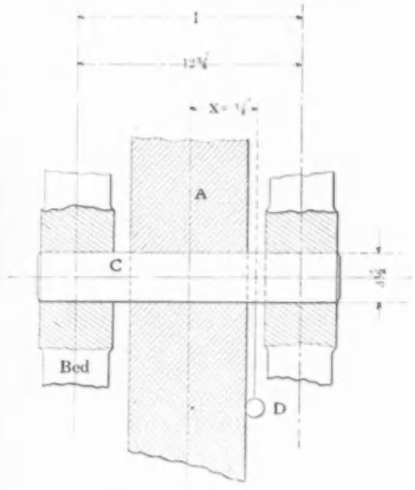


FIG. 8. THE BULL-WHEEL SHAFT

### POSITIONS OF THE INSTRUMENTS

Instruments were placed to get readings at the following parts of the machine:

1. Bull-wheel shaft.
2. Head and rear end of platen.
3. Points of compression of the elements composing the head.
4. Compression of cross-feed screw.
5. Deflection of cross-rail (horizontal and vertical).
6. Tipping of housings, and
7. Spreading of housings.

### DATA

Machine; see the two preceding sections.

Cutting speed; 25 feet per minute.

Tool; Taylor form for cast iron; Novo high-speed steel.

Depths of cut; 0.525 inch and 0.725 inch.

Feed per cut; 0.070 inch.

The machine rested on double flooring, 2-inch plank, 1-inch overlay (see Fig. 14 for beam positions).

### THE BULL-WHEEL SHAFT

This shaft is 3½ inches in diameter, and the distance from center to center of its bearings is approximately 12¾ inches. The relative points of application and delivery of power to and from this shaft are

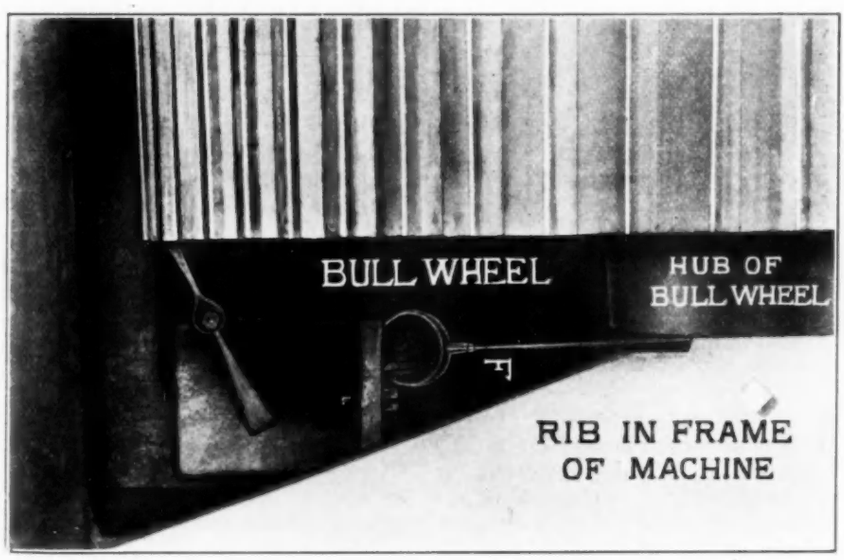


FIG. 7. LOOKING DOWN ON INSTRUMENT FOR MEASURING DEFLECTION OF BULL-WHEEL SHAFT

shown in Fig. 6. The pinion contact is 90 degrees from the rack contact. These two forces are shown by the dotted arrows. If we neglect friction and regard these two forces as equal, the resultant will be located at an angle of 45 degrees with the horizontal. The measurement of deflection of this shaft was in the plane of this resultant.

Fig. 7 is a view looking directly down on the instrument for taking this deflection. The platen was run ahead and the long finger which has been inserted in the Ames instrument can be seen bearing against the shaft. The finger is indicated at *F*. The reading was taken by means of a mirror placed on the floor beneath the planer.

Fig. 8 is a sketch showing the arrangement of the parts of the machine at this point; *A* is the bull wheel, which runs on the shaft *C*. This shaft does not turn, but acts as a spindle on which the bull wheel turns; the shaft is fast in the frame of the machine. The position of this shaft relative to the whole machine is indicated at *Z*, Fig. 3. The instrument for reading deflections is indicated at *D* in Fig. 8.

The first series of tests—four in number—was run under a cut of 0.525 inch; the last four were run under a cut of 0.725 inch. The deflection of the bull-wheel shaft, at the point where the indicator was applied, was 0.00075 inch under 0.525-inch cut and 0.0015 inch under a 0.725-inch cut. This is an increased deflection with an increased load, which we would, quite naturally, expect. There was no vibration of the shaft whatsoever; the shaft deflected as the cut entered each plate, and returned to its original position again as the cut went off; *a simple deflection and return to place.*

For the purpose of determining what the calculated deflection of this shaft would be in a theoretical case and comparing this with the actual result obtained, an auxiliary test was made, to find out, if possible, what pressure was exerted in a horizontal direction, by a chip 0.725 inch deep and 0.070 inch feed.

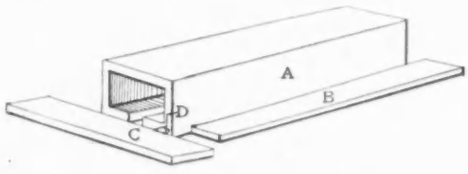


FIG. 9. ARRANGEMENT OF LEAD TEST CYLINDER

Fig. 9 illustrates the arrangement used to determine this pressure. Here *A* is a hollow, rectangular block; *B* is a cast-iron parallel piece bolted to the platen; one of these was on each side of *A*; *C* is a stop clamped to the platen. The piece *A* is fastened so that it is perfectly free to slide back and forth, but cannot move sidewise. The cut of 0.725 inch was started in, the planer was stopped, the piece *A* was moved ahead, and a lead cylinder *D* was inserted between *A* and *C*. The cut was taken, the lead cylinder removed, and its form as well as dimensions noted. This cylinder was originally 1 inch long and 1 inch in diameter. After compression it was *barrel* shaped; swelled at the middle. The average diameter at this swelled part was 1.2 inches and the length was 0.725 inch. The operation was repeated, and a second cylinder compressed under the cut to the same dimensions.

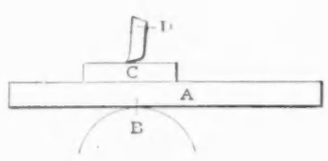


FIG. 10. DIAGRAM ILLUSTRATING THE RELATIVE POSITION OF TOOL, PLATEN AND BULL WHEEL

Another cylinder of exactly the same original dimensions was placed in a testing machine, and compressed to the same length. This cylinder took the same form and was the same average diameter at the largest part. These cylinders are shown in Fig. 15, and are marked "machine" and "test." The one marked "machine" was compressed in the planer under cut; the one marked "test" was compressed in the testing machine. It required a pressure of 4200 pounds to compress the cylinder to this size and shape.

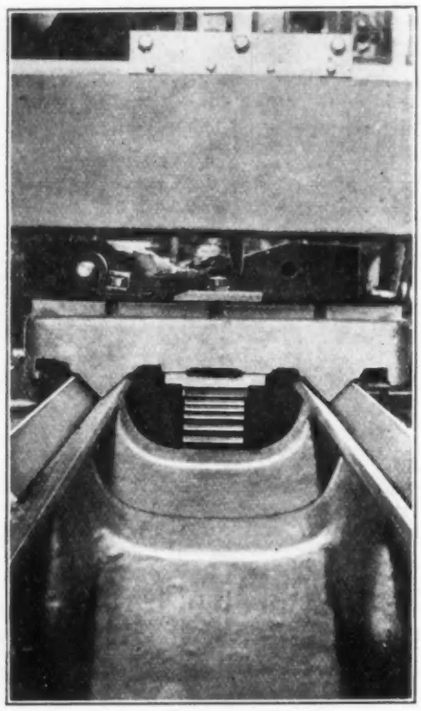

FIG. 11. PLATEN LIFTED UNDER 0.725-INCH CUT, FEED 0.073 INCH

This load was used as the horizontal force necessary to sustain the piece against movement lengthwise. Looking at Fig. 6 we see that the resultant of the two acting forces is at an angle of 45 degrees with the horizontal. Inserting the value given above and the *sine* of 45 degrees, which is 0.707, we have

$$\frac{4200}{0.707} = 5940 \text{ pounds},$$

the actual stress on the shaft in a plane at 45 degrees with the horizontal.

The position of this instrument, relative to the length of the shaft is well indicated in Fig. 8; while a view of it may be seen, as mentioned, in Fig. 7. Here the various parts of the machine, relative to the instrument can be studied better in detail. The excellent support of the bull wheel, and rigid design of the bed at this point are clearly presented by this halftone.

For the sake of comparison of the actual results obtained and the deflection which might be expected due to this load, I made a brief calculation. Following is the formula used:

$$E\,I\,y = \frac{P}{2}\left(\frac{l\,x^2}{4} - \frac{x^3}{6}\right)_{\text{(Church.)}} \quad (1)$$

The shaft was considered as a circular beam supported at the ends and loaded at the middle.

$E$ = Modulus of elasticity, taken as 30,000,000.

$P$ = Load applied, taken as 5940 pounds.

$I$ = Movement of inertia about center line of shaft (gravity axis), equals 7.36.

$x$ = Distance of point where measurement for deflection was taken from middle of shaft, equals $\frac{l}{4}$ = one-fourth whole length of shaft as indicated in Fig. 8.

$l$ = Length of shaft, taken as 12.75 inches.

$l^3 = 2072.67$.

$y$ = Deflection of the shaft at any given point.

Substituting the values we find that a deflection of 0.00036 inch may be expected. The calculation is not gone through with here as it is somewhat lengthy, and the data given above are all that are needed, if it is desired to verify the result.

The purpose of making this test and calculation was not to introduce theoretical niceties, but to see how nearly to calculated results we came in actual practice.

## The Platen

This element was tested for deflection from a normal position, both at the head and rear ends. A detailed view of the instrument is given in Fig. 1, and another view in Fig. 3, where the line can be seen with the sliding post resting on it. An-

other instrument of the same sort was fixed at the head end of the platen with the sliding post resting on the same wire. The uprights supporting this wire were about 25 feet apart. The wire was drawn up as tightly as possible by means of the key already described. There was, of course, a certain amount of sag to the wire, but the method of taking the reading eliminated any error from this source. The post at *B* was about 4 feet from the machine, while the one at the head end was about 8 feet from the end of the bed. The posts were thus free from change of position, caused by jar from the running machine.

The method of taking the readings on these instruments, as well as all others, was, first to run a stroke of the machine without a cut, and immediately follow with a stroke under cut. In this particular case, the first stroke gave the reading due to the sag of wire, and position of platen without a load, while the second gave a reading with a load. The difference between these gave the deflection due to the cut.

Under the 0.525-inch cut there was a compression of the parts; that is, the platen settled *down* 0.009 inch at the head end and 0.012 inch at the rear end. These readings were repeated on different days, and were always the same. The cuts were taken from right to left (Fig. 3) in every

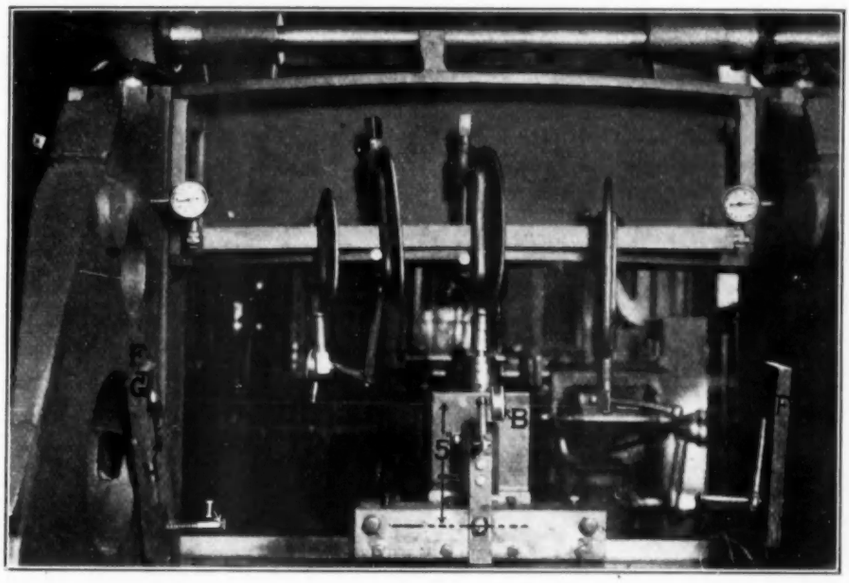


FIG. 13. ATTACHMENT OF INSTRUMENTS FOR MEASURING CROSS DEFLECTION OF HOUSING

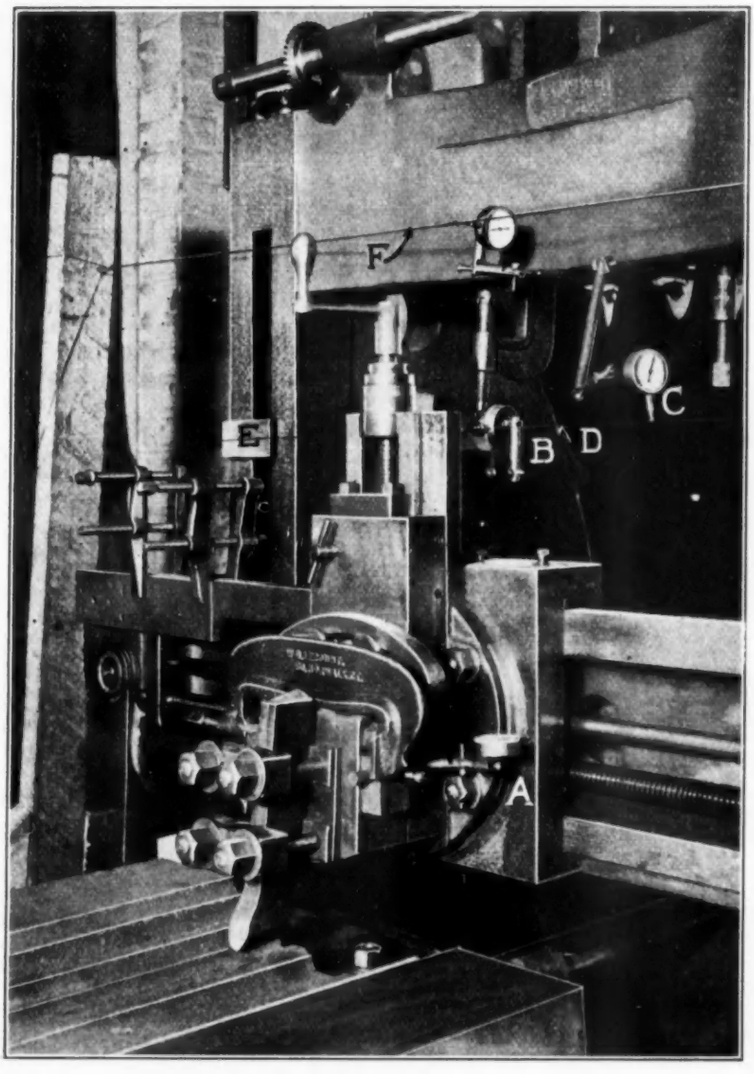


FIG. 12. INSTRUMENTS FOR MEASURING HEAD, RAIL AND HOUSING MOVEMENTS

test. The platen deflections remained unchanged, as the chip crossed the work; that is, while the instruments were fixed on the left edge of the platen, the readings were the same when the cut was 18 inches from them, as when it was 6 inches. This indicates that the platen does not twist under the cut, but it *does settle*.

The action directly beneath the tool is, then, one of simple compression; when the front end of the platen goes down the rear end does not lift, as the reading of the rear end instrument is the same whether the machine is under cut or running idle. The same is true of the head end instrument. The deflection shows only as the instrument approaches the tool and becomes a maximum when the tool is in line with it.

A study of the acting forces will lead us to expect a greater deflection at the rear end than at the front, for the moment, created by the action of bull wheel and cutting tool tends to depress the rear end and litt the front end clear of the bed, if we consider the platen as a free body; a glance at Fig. 10 will show this clearer; *A* is the platen, *B* the bull wheel and *D* the tool. The tendency at the head end is to lift the platen clear of the bed, which we will see later it actually does when the chip is heavy enough; at the rear end, however, there is no such action at any time. Under a 0.525-inch cut, this tipping action is not great enough to eliminate entirely a vertical downward force, hence the indication of a compression at the head end.

### Second Series—Chip 0.725 Inch

Under this cut the platen acted quite differently. Instead of compressing at the head end the platen lifted entirely free

from the bed (about 3/16 inch) as the cut started in. This is shown in Fig. 11, a photograph of the front end of the platen, looking along the ways when the platen is lifted due to the cut. The platen gradually resumed its place on the ways as the cut proceeded, and at the rear end indicated a compression of 0.040 inch.

In order to study this change from compression to lift of the platen under cut, and see if it would act the same under different conditions, a cut was started at about 0.200 inch-depth (0.070-inch feed) and allowed to increase to 0.525 inch and 0.725 inch. Under the 0.200-inch

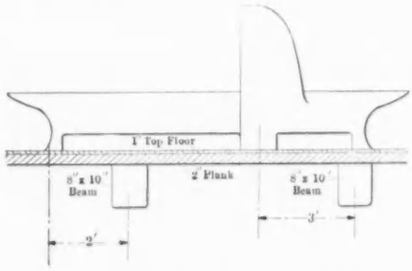


FIG. 14. POSITION OF PLANER WITH REFERENCE TO FLOOR BEAMS

cut no displacement of table was indicated; under the 0.525-inch cut there was the same compression at both head and rear ends, as already given; under the 0.725-inch cut there was again the marked lift and marked compression.

The belts were not under too great stress at any time, and were of sizes indicated by the pulleys of the machine.

The matter of getting accurate work can be settled by taking lighter cuts, but as occasion arises in every shop for taking heavy cuts, we could get this accuracy in less time, and with less wear on the machine, if it was more rigid.

### Test of Elements Composing the Head

The instrument for measuring the compression of these members is shown at *A*, Fig. 12. The method of attaching is shown clearly in the photograph. The instrument gives a reading for compression between the tool box and apron face; it includes the following elements: Tool block, slide and swivel. The maximum compression was 0.006 inch and took place just as the tool started into the cut on each plate. After the cut was well in, the instrument indicated a decreasing stress, and a constant compression of 0.0015 inch for the 0.525-inch chip, and 0.002 inch for the 0.725-inch chip. The compression of 0.006 inch, as given above, was due to vibration. The various parts of the machine "jumped back and forth," perhaps expresses the idea, until an equilibrium of forces was attained, when the needle of the instrument remained stationary.

### Cross-feed Screw

This screw was tested for compression. The instrument has been described and can be seen attached at the left end of the rail in Fig. 12. The purpose was to determine whether or not the screw was stiff enough to hold the head in place under the cut. In all cases, the head retained its position exactly as the feed left it. The diameter of the screw is 1 3/16 inches, lead ¼ inch, single thread.

### The Cross-rail

This was tested for both horizontal and vertical deflection. The horizontal was from a normal position, and the vertical measurement relative to the tie rail at the top of the housings. The arrangement of the instruments is shown in Fig. 12; *B* is the instrument for reading the horizontal deflection, and *C* the one for the vertical. The finger of *B* presses against the wire *D*, which is held in position by drawing over blocks on each housing face and fastened as shown in Fig. 13 at *F*. The wire was passed around, through openings in the side of the housing, and through the slot *G* in the board. It was then drawn as tightly as possible with the key *H* and the board was set rigidly in place by turning the screw *I* slightly.

There was no deflection in the vertical plane under any cut, the rail was amply stiff *vertically* to sustain all cuts up to and including 0.725 inch without deflection.

The instrument for measurement of horizontal deflection gave a reading of 0.003 and 0.005 inch, for 0.525 inch and 0.725-inch chips, respectively. The vibration ranged from 0.007 to 0.0010 inch. Here again, the vibration took place as the cut started on each plate; after the cut was well in, the instrument showed the deflections given above, with a vibration of about 0.001 inch.

In studying this result, however, we have a very important fact to consider, viz: This movement was not a movement backward in a horizontal plane, but a movement forward; as the cut came on the rail tipped forward. These readings were the same in every position of the head as it traveled across the platen.

### The Housings

These were tested for deflection parallel to the line of travel of the platen, and also perpendicular to it. The first measurement was from a normal position, relative to the wire *F*, Fig. 12. The wire was held in position by uprights *C*, Fig. 3, as already explained, and is marked *F* in this figure. A very clear idea of the relative positions of uprights supporting the wire and the machine can be obtained by a study of figure *B*. The machine was not set on a separate foundation but on a double floor of 2-inch plank,

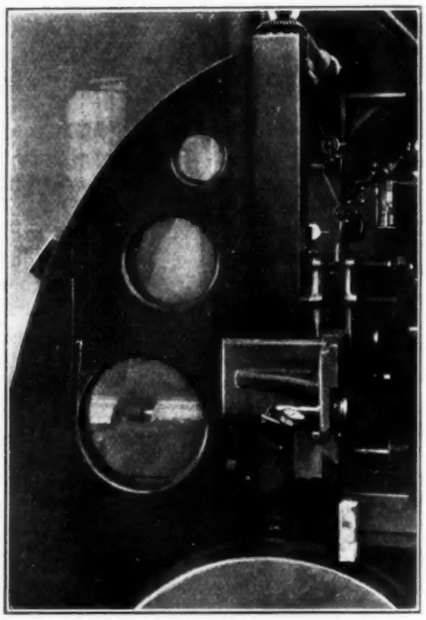

FIG. 16. GENERAL PROPORTIONS OF HOUSING

covered by 1-inch top flooring. Fig. 14 shows the setting of the planer relative to the floor beams, and in view of the housing deflections a careful study of this figure will be worth one's time.

When the machine was running without a cut the housings showed an average movement of 0.053 inch from a normal position. Thus when the platen was run back the full length of the stroke, with the three plates used for the test in place, the reading of instrument was taken as 0. When it was in the extreme position ahead, the uprights had tipped back 0.053 inch. The average deflection of the housings under a cut of 0.524 inch was 0.059 inch, or a deflection due to load of 0.006 inch; under a cut of 0.725 inch the deflection was 0.065 inch, or a deflec-

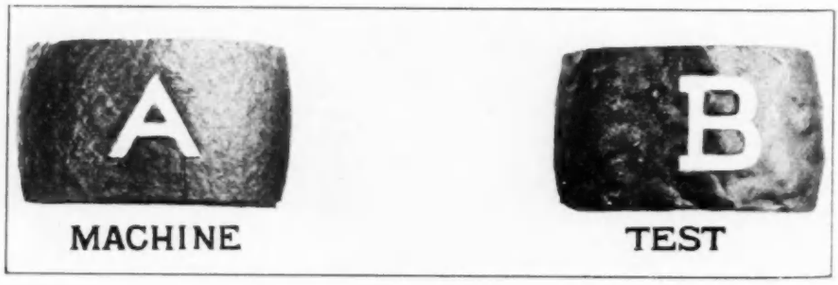


FIG. 15. LEAD CYLINDERS AFTER COMPRESSION

tion due to load of 0.012 inch. In all tests the rail was close down to the work, and all gibs were set up, so that movement of the various parts of the machine was somewhat stiff. If the rail had been higher on the uprights, these readings would probably have been somewhat larger.

An interesting point in connection with this part of the test was the fact that when the cut starts in on Plate 1, Fig. 3, the uprights tipped forward 0.002 inch, instead of tipping backward, showing that the twisting effect on the rail was transmitted to the uprights. This effect did not show as the cut started in on plates 2 and 3.

It was thought that possibly the wire *F*, Fig. 3, was affected by the platen running back and forth, thus causing a movement of the floor, and thus the uprights. A test to verify the above results was made as follows: A spirit level was placed on the knee *M*, Fig. 3, and the same direction of deflection could be observed; this did not, of course, check the AMOUNT of deflection. The level placed on top of the uprights at *N* showed no movement, whether machine was running under cut or idle. The deflections were the same as the cut traveled across the platen; the position of the head making no difference in deflection.

Fig. 16 is shown to give an idea of the general proportions of these uprights. I think it will be generally admitted that the proportions are those of as rigid a tool, of this class, as we can find. The joint between upright and bed is shown at *O*, Fig. 3, and the bolts holding the upright at this point were all that could be required considering the area of the surfaces in contact.

### DEFLECTIONS OF HOUSINGS RELATIVE TO TIE RAIL

The attachment of instruments for measuring this deflection is shown in Fig. 13. The tie rail is bolted to the housings by means of four ½-inch bolts, two at each end. The vibration was about 0.002 inch and the actual deflection about 0.0005 inch under a 0.725-inch cut. With the 0.525-inch cut the deflection was slightly under this amount, the angle opened indicating a spreading of the housings.

It will be noted, in the report of this test that no questions have been answered; about all that has been shown is: A certain machine deflects so much at certain points when using a modern high-speed steel tool. Is it necessary to overcome these deflections in future design? If it is, in what way should it be done?

Answers to these questions by any one man cannot be as valuable to the industry as answers by a great many. The facts have been presented and the method followed in getting such facts has been given. The problem may be considered as presented in a fairly definite way. The answers may be given and conclusions drawn by AMERICAN MACHINIST readers.

The test is not exhaustive; it has simply pointed out some places where the machine springs when at work; it was not a hair-splitting process of refinement, as only such results as would be of value in practice were given any consideration.

## The Calibrating of Twelve Ames Dial Gages

BY WALTER GRIBBEN

A series of twelve dial gages was to be compared with Swedish gages loaned to us for the purpose by the Gronkvist Drill Chuck Company, of Jersey City, N. J., to find out if the former were in error; the latter were accepted for the purpose as the standard. The dial gages were stock gages furnished by the B. C. Ames Manufacturing Company, of Waltham, Mass., and were to be used in a rigidity test on a metal planer. A companion article describes the planer test. The results of the calibration show a surprising uniformity on the part of the dial gages. It should be pointed out that the Swedish gages gave a very easy method of calibrating.

In order to identify the dial gages, each one had a number stamped on the lug at the rear side, the numbers running from 1 to 12, inclusive. The half tone, Fig. 1, shows the method of making the comparisons. The fixture at the corner of the surface plate was to hold the dial gages, one at a time, with the plungers in a vertical position, while the small angle iron clamped to the surface plate served to rest the standard gages on while testing. This arrangement gave more room for the fingers to work in than would have been the case were the standard gages placed directly on the surface plate.

The dials on the gages to be tested are adjustable, so as to have the zero come at any desired point, but all through the tests here described the dials were so set that the hands rested between 99 and 0, when nothing was in contact with the plunger, and in the rigidity tests for which the dial gages were subsequently used, the dials were set in the same way. This was to eliminate any error due to faulty graduation of the dials, as the tests of the dial gages against the Swedish gages gave the net result of all the different kinds of errors possible in the former; such as, faulty spacing of pinions, gears or racks, eccentric gears, faulty shape of gear teeth, and faulty or eccentric graduation of the dial itself. So it was important to have the dials occupy the same position in relation to the moving parts, both when they were being compared with standards, and also when they were used as standards themselves later on. Every

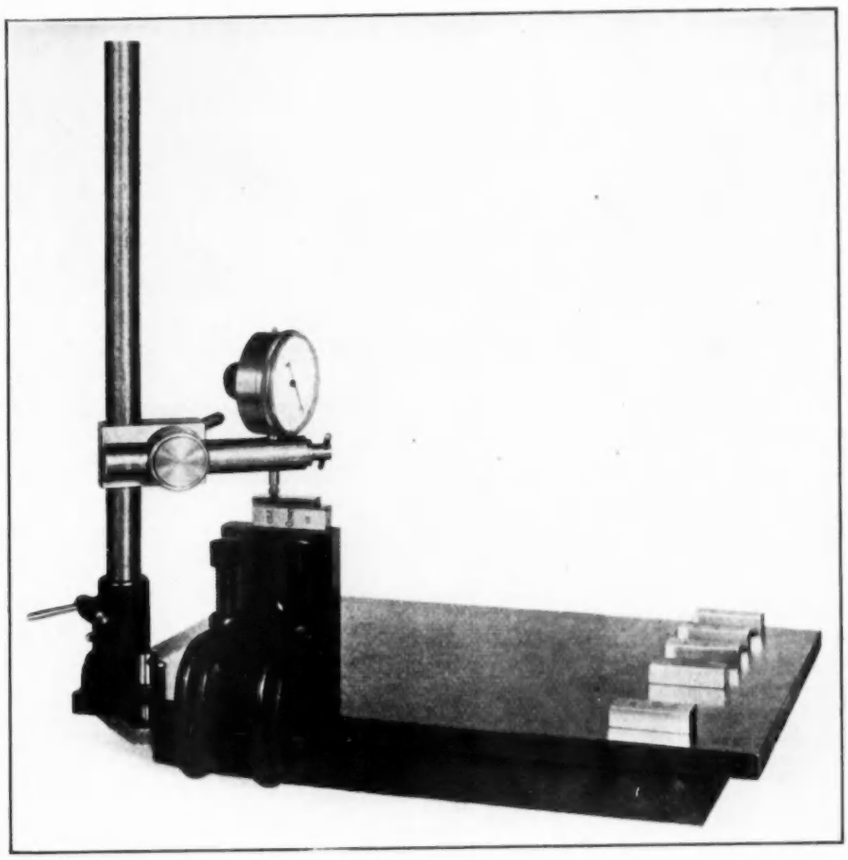

FIG. 1. METHOD OF CALIBRATING AMES DIAL GAGES

tenth division on the dials was tested; this was thought to be sufficient.

### Method of Calibrating

The method of making the comparisons was to use the 0.500-inch gage as a datum block, and then use other gages, built up in combinations to make 0.510, 0.520, 0.530, 0.540 and 0.550, shown in a row at the side of the surface plate. The dial gage was so set in the holding fixture that when the 0.500-inch gage was placed under it the hand pointed to 0. Then the 0.500 was removed and the 0.510 put in its stead, when the hand should point to 10 if the dial gage was correct. Then the 0.510 was taken out and the 0.520 put under the dial gage which then ought to read 20; and so on up to 0.550. After this the 0.500 datum block was put back again to make sure nothing had shifted. In case the dial did not then read 0, the five observations just made were thrown out and the tests were gone through with again. In other words, in order that the series of five consecutive observations should be of value, the zero point of the dial had to test the same immediately before and after the series of five observations was made. After testing No. 1 dial gage with the above six blocks, No. 2 was put in the fixture and tested with the same six blocks, and so on until the twelve gages were tested from 0 to 50.

The next step was to build up the standard gages to the values of 0.560, 0.570, 0.580, 0.590 and 0.600, using the 0.500 block immediately before and after this new series of standards. After testing the entire lot of twelve-dial gages with this series, a third series was built up of the values 0.500, 0.610. 0.620, 0.630, 0.640 and 0.650, and the twelve dials tested with these. This process was kept up until the limit of movement of the hands on the dials was reached.

The reason for using the standard gages in a series of six values at a time instead of testing one dial gage throughout its entire range of movement before taking up another dial, was to guard against temperature errors as much as possible. In building up the standard gages to obtain the required values, they had to be handled quite a while during the building process, and some of the components were rather small pieces of steel that would warm up quickly; whereas, after the standards were built up, they contained a larger mass of metal that would warm up slowly. Besides the operation of lifting them from the surface plate up to the testing position occupied a comparatively short space of time; also their contact with the mass of iron in the surface plate for some length of time would tend to hold them at the temperature of the room, which was kept about 65 degrees Fahrenheit during the tests, and for about two hours before the tests began. The reason for using the 0.500 gage as a datum block was so as to have the smallest gage of the series large enough to handle conveniently, and not warm up too quickly.

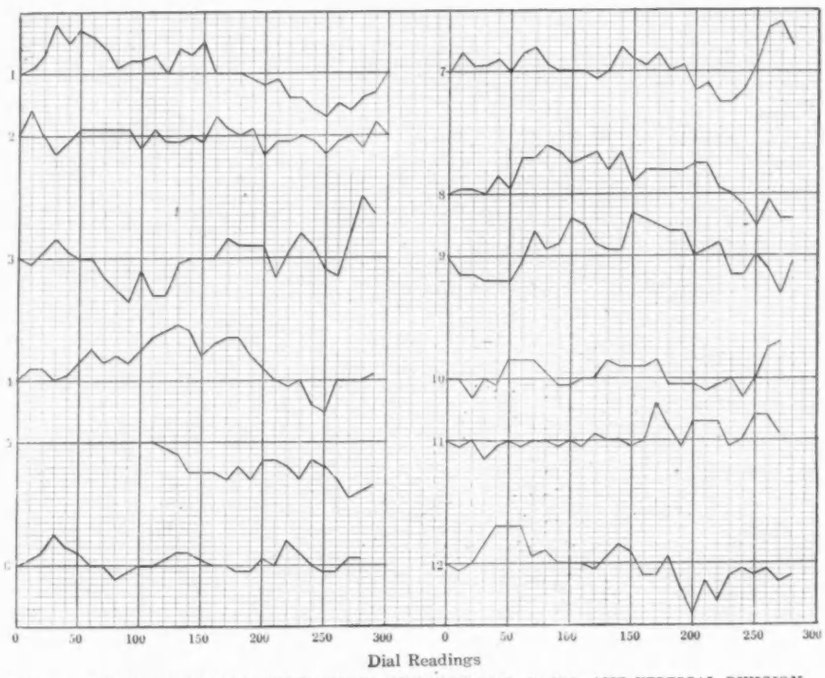


FIG. 3. CURVES SHOWING UNIFORMITY OF AMES DIAL GAGES, ONE VERTICAL DIVISION REPRESENTS 0.0001 INCH

| Swedish Gauge Values. | Identification Numbers. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 0.500 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 0.510 | 0.0101 | 0.0104 | 0.0099 | 0.0102 | 0.0100 | 0.0101 | 0.0103 | 0.0101 | 0.0097 | 0.0100 | 0.0099 | 0.0099 |
| 0.520 | 0.0203 | 0.0200 | 0.0201 | 0.0202 | 0.0200 | 0.0202 | 0.0201 | 0.0201 | 0.0197 | 0.0197 | 0.0200 | 0.0200 |
| 0.530 | 0.0308 | 0.0297 | 0.0303 | 0.0300 | 0.0300 | 0.0305 | 0.0301 | 0.0300 | 0.0296 | 0.0300 | 0.0297 | 0.0303 |
| 0.540 | 0.0405 | 0.0399 | 0.0401 | 0.0401 | 0.0400 | 0.0403 | 0.0402 | 0.0403 | 0.0396 | 0.0399 | 0.0399 | 0.0406 |
| 0.550 | 0.0507 | 0.0501 | 0.0500 | 0.0503 | 0.0500 | 0.0502 | 0.0500 | 0.0501 | 0.0496 | 0.0503 | 0.0500 | 0.0506 |
| 0.560 | 0.0606 | 0.0601 | 0.0600 | 0.0605 | 0.0600 | 0.0600 | 0.0603 | 0.0606 | 0.0599 | 0.0603 | 0.0599 | 0.0606 |
| 0.570 | 0.0704 | 0.0701 | 0.0697 | 0.0703 | 0.0700 | 0.0700 | 0.0704 | 0.0706 | 0.0704 | 0.0703 | 0.0700 | 0.0701 |
| 0.580 | 0.0801 | 0.0801 | 0.0795 | 0.0804 | 0.0800 | 0.0798 | 0.0801 | 0.0808 | 0.0801 | 0.0801 | 0.0800 | 0.0802 |
| 0.590 | 0.0902 | 0.0901 | 0.0893 | 0.0903 | 0.0900 | 0.0899 | 0.0900 | 0.0907 | 0.0902 | 0.0899 | 0.0899 | 0.0900 |
| 0.600 | 0.1002 | 0.0998 | 0.0998 | 0.1005 | 0.1000 | 0.1000 | 0.1000 | 0.1005 | 0.1006 | 0.0999 | 0.1000 | 0.1000 |
| 0.610 | 0.1103 | 0.1101 | 0.1094 | 0.1107 | 0.1100 | 0.1100 | 0.1100 | 0.1106 | 0.1105 | 0.1100 | 0.1099 | 0.1100 |
| 0.620 | 0.1200 | 0.1199 | 0.1194 | 0.1208 | 0.1199 | 0.1201 | 0.1199 | 0.1207 | 0.1202 | 0.1200 | 0.1201 | 0.1199 |
| 0.630 | 0.1304 | 0.1299 | 0.1299 | 0.1309 | 0.1298 | 0.1302 | 0.1300 | 0.1304 | 0.1301 | 0.1303 | 0.1300 | 0.1301 |
| 0.640 | 0.1403 | 0.1400 | 0.1400 | 0.1408 | 0.1395 | 0.1402 | 0.1404 | 0.1407 | 0.1401 | 0.1402 | 0.1400 | 0.1403 |
| 0.650 | 0.1505 | 0.1499 | 0.1500 | 0.1504 | 0.1495 | 0.1501 | 0.1502 | 0.1502 | 0.1507 | 0.1502 | 0.1499 | 0.1502 |
| 0.660 | 0.1600 | 0.1603 | 0.1600 | 0.1606 | 0.1595 | 0.1600 | 0.1601 | 0.1604 | 0.1606 | 0.1602 | 0.1600 | 0.1598 |
| 0.670 | 0.1700 | 0.1701 | 0.1703 | 0.1707 | 0.1694 | 0.1700 | 0.1703 | 0.1704 | 0.1705 | 0.1703 | 0.1706 | 0.1698 |
| 0.680 | 0.1800 | 0.1800 | 0.1802 | 0.1807 | 0.1796 | 0.1799 | 0.1800 | 0.1804 | 0.1804 | 0.1799 | 0.1802 | 0.1801 |
| 0.690 | 0.1899 | 0.1901 | 0.1902 | 0.1904 | 0.1895 | 0.1899 | 0.1901 | 0.1904 | 0.1904 | 0.1899 | 0.1899 | 0.1896 |
| 0.700 | 0.1998 | 0.1997 | 0.2002 | 0.2002 | 0.1998 | 0.2001 | 0.1997 | 0.2005 | 0.2000 | 0.1999 | 0.2003 | 0.1992 |
| 0.710 | 0.2099 | 0.2099 | 0.2097 | 0.2100 | 0.2098 | 0.2100 | 0.2098 | 0.2105 | 0.2101 | 0.2098 | 0.2103 | 0.2097 |
| 0.720 | 0.2196 | 0.2199 | 0.2201 | 0.2199 | 0.2197 | 0.2204 | 0.2195 | 0.2201 | 0.2202 | 0.2199 | 0.2203 | 0.2194 |
| 0.730 | 0.2296 | 0.2300 | 0.2304 | 0.2300 | 0.2295 | 0.2302 | 0.2295 | 0.2300 | 0.2297 | 0.2300 | 0.2299 | 0.2298 |
| 0.740 | 0.2394 | 0.2399 | 0.2402 | 0.2396 | 0.2398 | 0.2400 | 0.2397 | 0.2398 | 0.2397 | 0.2397 | 0.2400 | 0.2399 |
| 0.750 | 0.2493 | 0.2497 | 0.2498 | 0.2495 | 0.2497 | 0.2499 | 0.2501 | 0.2495 | 0.2500 | 0.2500 | 0.2504 | 0.2498 |
| 0.760 | 0.2595 | 0.2599 | 0.2597 | 0.2600 | 0.2595 | 0.2599 | 0.2607 | 0.2599 | 0.2598 | 0.2605 | 0.2604 | 0.2599 |
| 0.770 | 0.2694 | 0.2700 | 0.2704 | 0.2700 | 0.2692 | 0.2701 | 0.2708 | 0.2696 | 0.2694 | 0.2706 | 0.2701 | 0.2697 |
| 0.780 | 0.2796 | 0.2798 | 0.2810 | 0.2800 | 0.2793 | 0.2801 | 0.2804 | 0.2796 | 0.2799 | | | 0.2798 |
| 0.790 | 0.2897 | 0.2902 | 0.2907 | 0.2901 | 0.2894 | | | | | | | |
| 0.800 | 0.3000 | 0.3000 | | | | | | | | | | |

FIG. 2. TABULAR VALUES FROM THE CALIBRATION.

The dial gages were graduated to read to 0.001 inch, but by using a magnifying glass of 3-inch focus, 0.0001 inch on the dial could be estimated. The extremity of the hand was bent down by the makers so as to be close to the dial and thus avoid error of parallax, but to still further guard against this error, the head was shifted about until the image of the magnifier, as seen reflected from the glass covering the dial, appeared to be bisected by the hand. Then the eye was known to be in a plane passing through the hand at right angles to the plane of the dial.

### The Results

The tables, Fig. 2, show the reading of the dial gages corresponding to the standard values of the Swedish gages, while the curves, Fig. 3, plotted from the tabular values show graphically the results obtained by the comparisons. The horizontal heavy lines are datum lines for the error curves, while each of the light horizontal lines represents 0.001 inch error, the curve going above the datum

line when the reading of dial gage was in excess of what it should be, and below the datum line when the reading was too little. Thus, for No. 1 dial gage the maximum excess error was 0.0008 and occurred when the dial read 30, while the maximum deficiency error was 0.0007 and occurred when the dial read 250.

One fact that was brought out by plotting the errors was that some of the dial gages were more accurate than others, while in some of them one part of the range of movement was more accurate than another part of the range in the same dial. No. 5 seems to be the best dial gage of the lot, as no error was apparent up to 110, while beyond that point the errors are not as much as in Nos. 3, 4, 8 and 9.

## Molding a Large Gear Wheel

By W. W. Carter

It is not infrequent that jobs like that illustrated in the accompanying drawings are performed in foundries that are engaged in molding heavy work. In point of economy in patternmaking, and, also, that of molding, the following method has already proved to be by far the most economical and practicable. The casting when finished will be an involute toothed gear wheel with six arms.

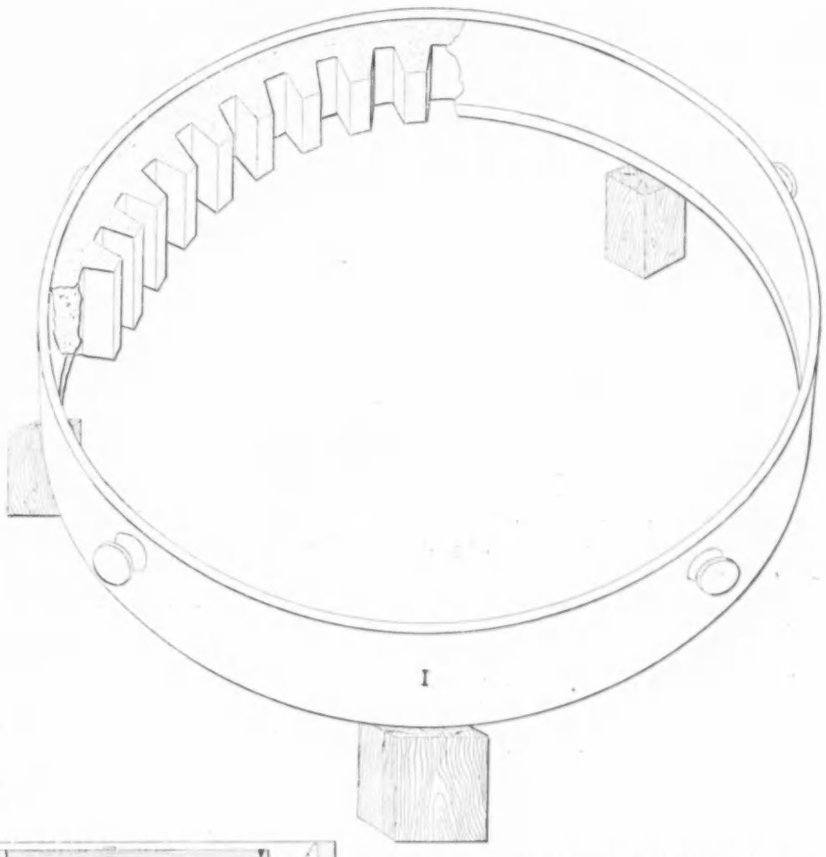


FIG. 3. PERSPECTIVE OF CHEEK RESTING ON BLOCKS

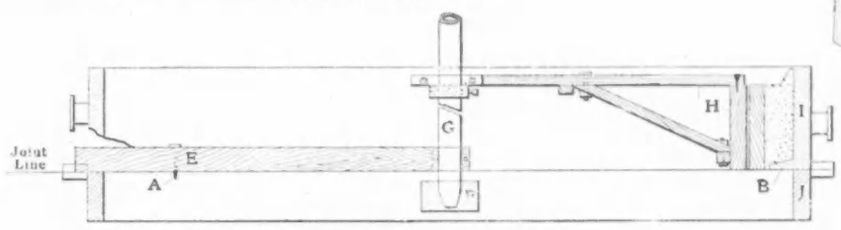


FIG. 1. SHOWING FLASKS WITH SWEEPS IN POSITION

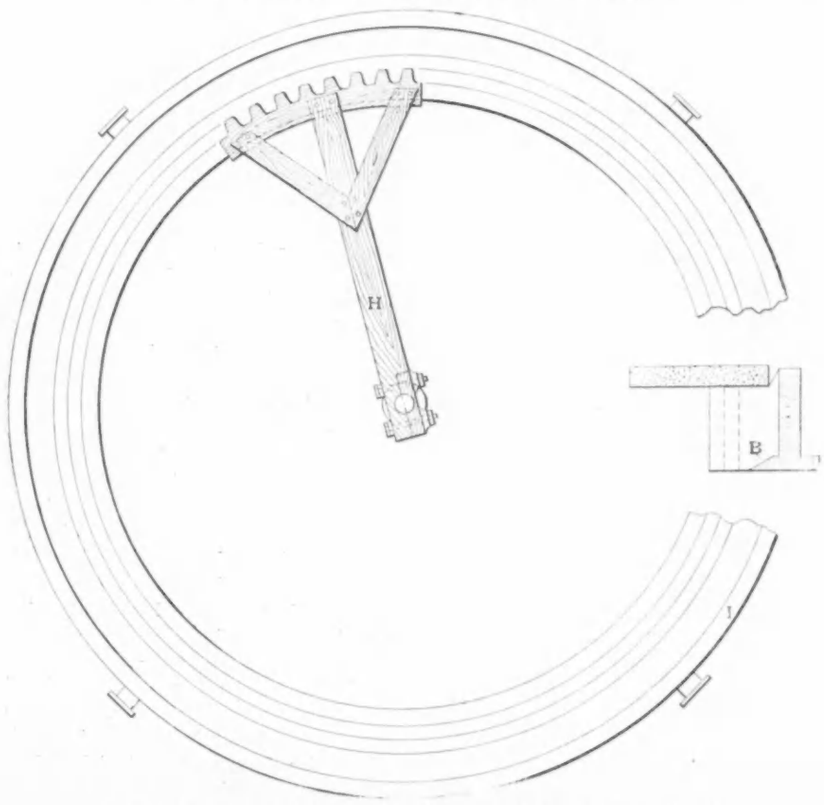


FIG. 2. PLAN VIEW OF CHEEK WITH TEETH SEGMENT IN POSITION

It is molded in a round iron flask, and the first operation is to strike off the drag part of the flask, level with its top edge, then the iron *F*, Fig. 1, with a hole for the sweep spindle is located in the center of the drag and sweep *E* is used to strike a circle which is divided into sixths for the purpose of getting the center line for each arm.

Sweep *E* is then removed and sweep *H*, which contains the segment of teeth, is placed as shown in Figs. 1 and 2. The top of the drag is next supplied with parting sand and the cheek *I*, is put on. This has a flange on the inside, as shown at *B*, to lift the sand surrounding the teeth. The teeth are then rammed up, or rather, in the molder's parlance, the cheek is rammed up. The matter of proceeding to ram up the cheek is, however, accompanied with more or less preliminaries relating to the correct setting of the segment sweep. This being satisfactorily accomplished the teeth on it are subsequently rammed up, each tooth being amply rodded for the purpose of supporting them when the cheek is lifted off, and then the segment is moved around and another set of teeth is rammed up, this operation being repeated until the circle is completed.

Incidentally, in most all operations of making large gear wheels the teeth are either nailed or rodded regardless of whether they are to be cheeked off or not. There are, however, some instances where a nail or rod is not needed at all, owing to the size and shape of the tooth. When the job is to be cheeked off care should always be exercised regarding the distance from which the nail, or rod is set to the bottom joint or flask parting; that is, a very little hanging sand should intervene between the rod and the joint.

When the cheek is rammed up, it should be lifted from the drag and lowered upon three blocks as shown in Fig. 3. The arm cores should then be swung upon the crane and lowered into position, locating them by the center lines made in the sand of the drag. These are shown in their proper location on the drag by Fig. 4. The backing board *K* with the rib *L* is then fastened to the ends of the arm cores and molding sand is rammed in between the said cores to form the inside ring of the wheel, as shown in Fig. 4.

It would be well just here to turn our attention for a few moments to the manner of making the arm cores. Fig. 5 shows a plan and sectional view of the core box for the arms and contains one-half of the arm pattern, two cores being made for each arm. These two cores are strengthened by means of a cast-iron arbor or crab and when dried they are matched together to form the arms. It is obvious that each core is only a half of an arm, but, it is, nevertheless, a whole core and it is made and handled as such, therefore, the two cores, being matched and clamped together are swung up and placed as already described.

When all the intervening spaces between the arm cores are rammed up, the different parts of the mold are given a swabbing of plumbago in solution with syrup water and a subsequent skin drying, then they are assembled, or, as the molder would say, the mold is closed and the covering cores at the hub and periphery are properly set, after which the mold is clamped and made ready to receive the metal. A sectional view of the closed mold, through the line *X X* of Fig. 4, is shown by Fig. 6.

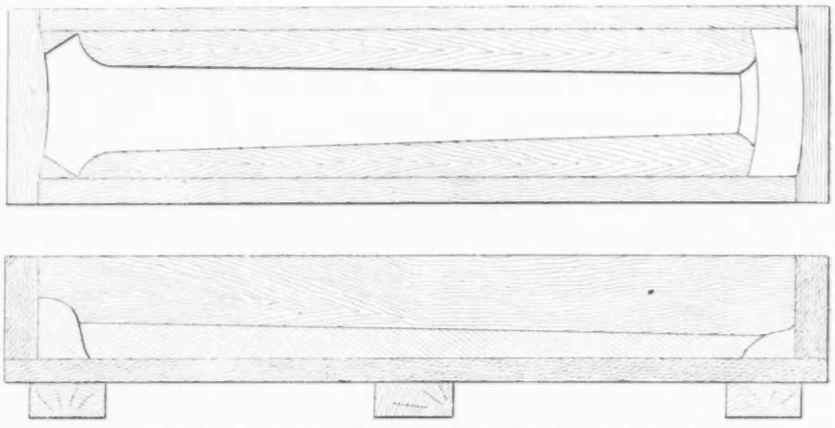

FIG. 5. PLAN AND SECTIONAL SIDE VIEW OF THE ARM CORE BOX

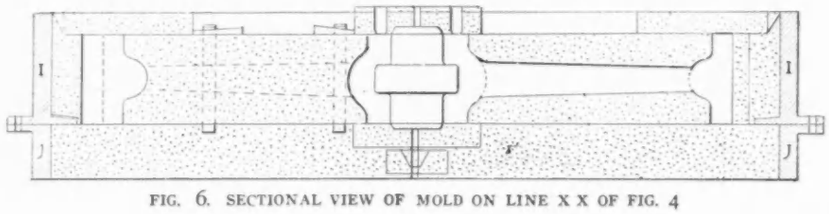


FIG. 6. SECTIONAL VIEW OF MOLD ON LINE X X OF FIG. 4

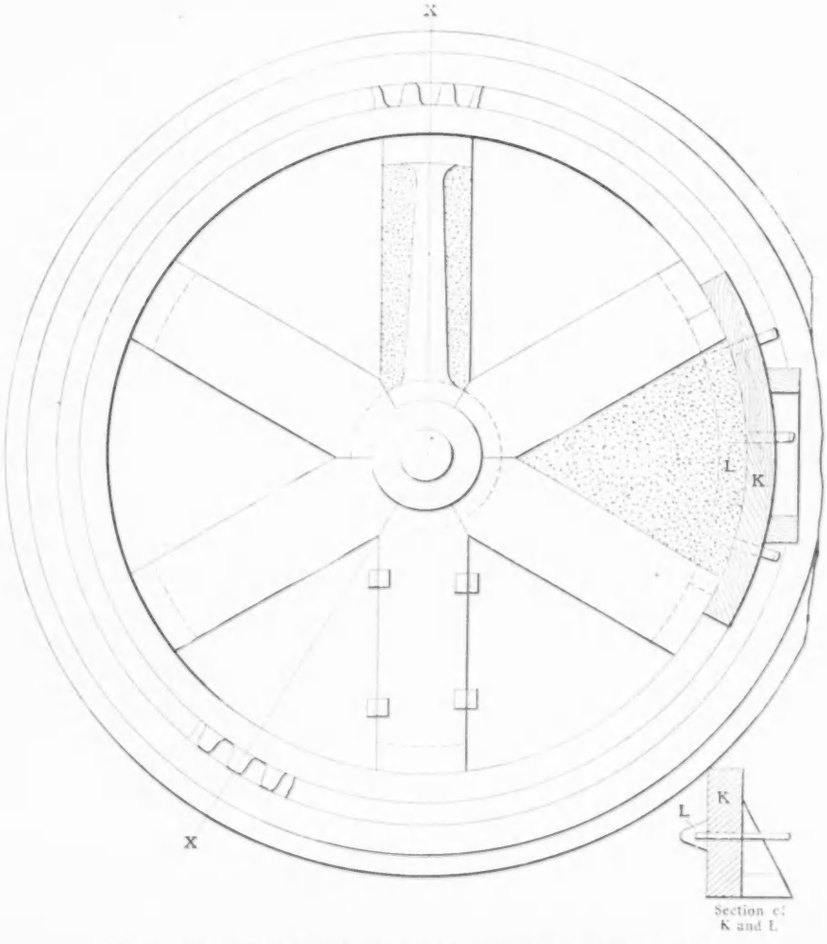


FIG. 4. ARM CORES LOCATED AND BACKING K IN PLACE FOR RAMMING SAND BETWEEN THEM

A new metallic mirror, partially made by electro-deposition, is being introduced on the market which is intended to replace glass particularly for marine purposes, such as search-light reflectors, etc. The mirror has a surface composed of alternate bands or rings of gold and white reflecting surfaces. It is claimed that this mirror gives a more penetrating beam of light both at night and in foggy weather, that objects on which such a beam of light is thrown stand out in greater relief than in a light thrown from a silver white metal mirror, and that the intensity of the light is so great that it is impossible to aim accurately at the projector. Another advantage claimed for the new mirrors is that they are not fractured by concussion, and that even when penetrated by bullets the area of distortion is very small.

The Belgian mint was quite active during 1907, producing silver, nickel, and copper Belgian coins, as well as nickel pieces for Roumania and Colombia. In all 67,000,000 coins were struck off, having a value of $1,768,000.

# Schaap Autogeneous Welding Process

## High Temperatures Obtained by Combining Gas with Air Under Pressure. The Burner and Apparatus Used. Some of the Work Done

## EDITORIAL CORRESPONDENCE

The welding process invented and patented with numerous patents by A. K. Schaap, of the Schaap Automobile Company, 344 Cumberland street, Brooklyn, N. Y., has created a wide interest in the mechanical world, in that it seems to have established a new principle by which high temperatures can be obtained, at a low cost, with the blow pipe or burner.

The principle, so far, has only been applied to the autogenous welding of metals, but it gives promise of having a much wider application, as it is very simple, and simplicity is a great cost reducer.

The entire apparatus necessary to weld the cast iron and aluminum parts which come to Mr. Schaap's shop is shown in Fig. 1, with the exception of a small air compressor, which is located on the floor below. In this cut the operator is seen holding the blow-pipe burner in his left hand, while in the right hand he is holding a bar of iron from which the metal is being melted into the opening, in the cylinder, that is being filled up. The metal that comes from the bar is being fused with the iron in the cylinder by the use of artificial gas for fuel, and the casting is made perfectly tight again without the use of any flux.

Breaks in cast-iron cylinders of this kind are welded together and the iron made solid and tight enough to withstand the high explosive pressures to which they are subjected by the rapidly repeated explosions of the gasolene gas. In fact, the iron at the weld is stronger than the rest of the casting, owing to the nature of the flame being such, that it purifies the metal which has been melted. The iron at the weld is not made hard, as is the case with some processes of mending casting, but is soft enough to be easily cut with a file.

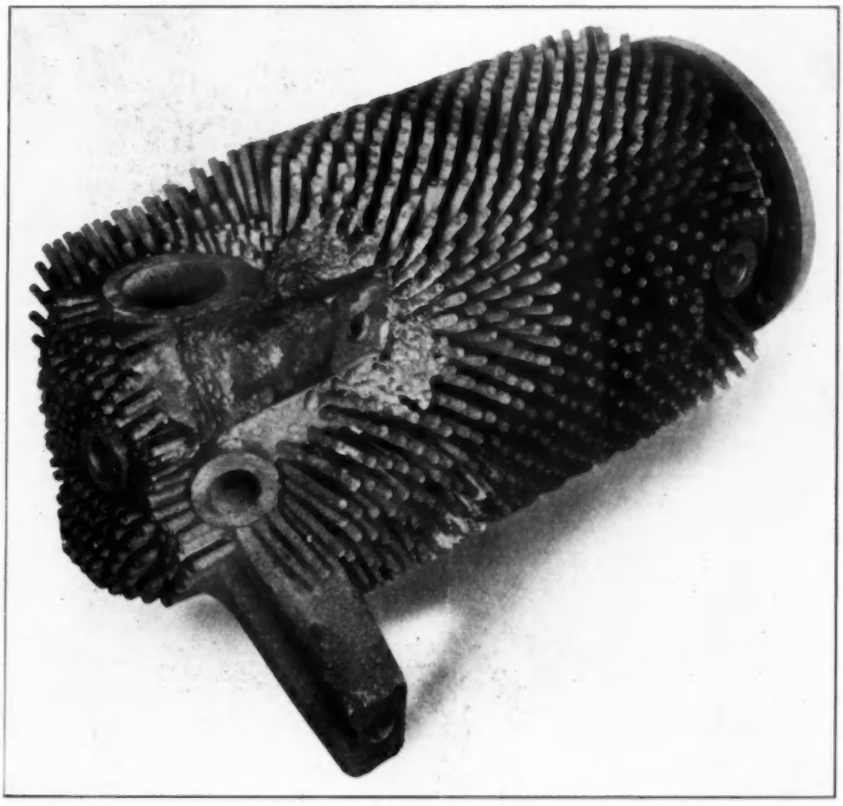

FIG. 2. CAST-IRON GASOLENE ENGINE CYLINDER WELDED WITH CITY GAS AND AIR BLAST WITHOUT FLUX

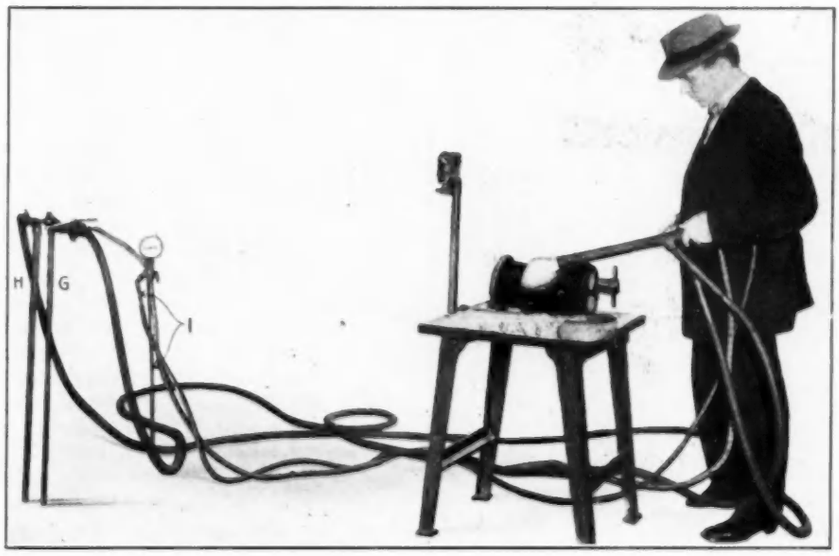


FIG. 1. WELDING A LUG ON A CAST-IRON CYLINDER WITH CITY GAS AND COMPRESSED AIR

The principle on which this process is based is the combining of several blasts of air, with gas as drawn from the city main, or any other gas, as acetylene, producer or natural gas will give a higher heat than the illuminating gas used in Fig. 1.

### The Burners Used

The burners or torches which form this combination of gas and air are shown in Fig. 3. Burner No. 1 is the first one which Mr. Schaap designed, and in this a blast of air at 2 pounds pressure per square inch, or less, was combined with gas from the main, and the flame regulated to as near perfection as possible. Then a blast of air from the air compressor, of from 40 to 60 pounds pressure per square inch was sent into the core of the flame and a temperature that would easily melt cast iron, in less than a minute, was obtained. Burners 3, 8 and 9 are smaller sizes of the same type that were

designed for small work, and for cutting metals.

After considerable experimenting burner 6, Fig. 3, was developed and this burner increased the temperature of the flame. It is the same burner that is shown in use in Fig. 1. At *A* in Fig. 3 gas is taken in from the city main; at *B* atmospheric air is taken in at a pressure of from 1½ to 2 pounds per square inch, and these two are mixed at *J;* another smaller blast of air, at 1½ to 2 pounds pressure, is taken in at *C* and combined with the gas and air taken in at *A* and *B;* gas combined with a blast of air from the air compressor, of from 40 to 60 pounds pressure, is taken in at *D* and carried through an inside pipe to the end of the burner. This blast forms the core of the flame; the hottest part of the flame is brought up close to the end of the burner, or extended out some 2 inches from it, by moving the inner pipe in and out by means of screw threads and the adjusting nuts *E* and *F*. The outer end of the outside pipe of the burner is surrounded with a row of small holes, located about ⅛ of an inch back from the end to allow any excess of gas to escape and be burned.

There is absolutely no danger of back-fire in this burner as it has been tested in all kinds of ways that would be liable to make it back-fire, and when in operation the outside of the burner is cold clear to the tip end, while the heat 1 inch from it is hot enough to quickly melt cast iron or steel.

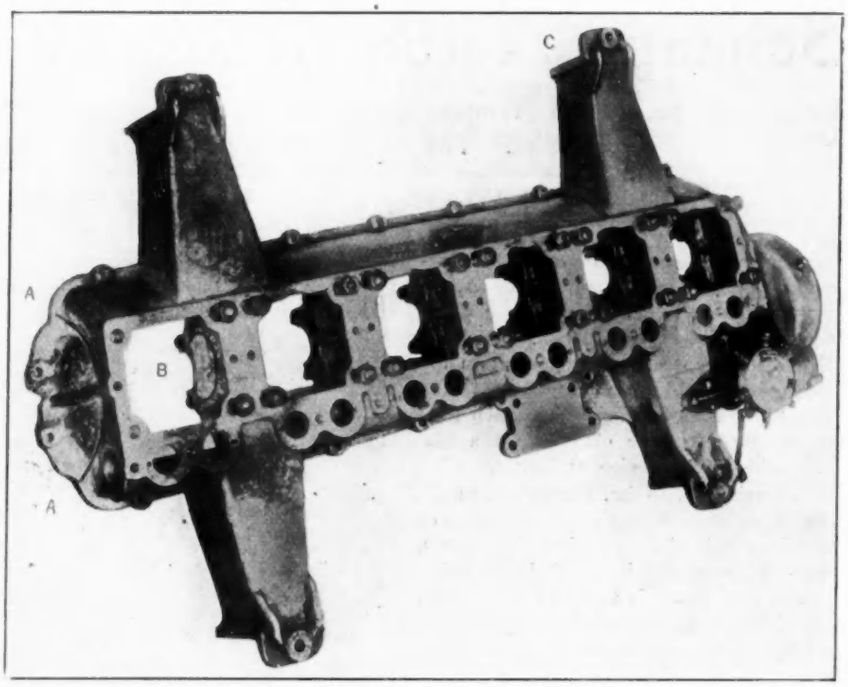


FIG. 4. SIX CYLINDER ALUMINUM CRANK CASE WELDED WITH CITY GAS AND AIR BLAST WITHOUT FLUX

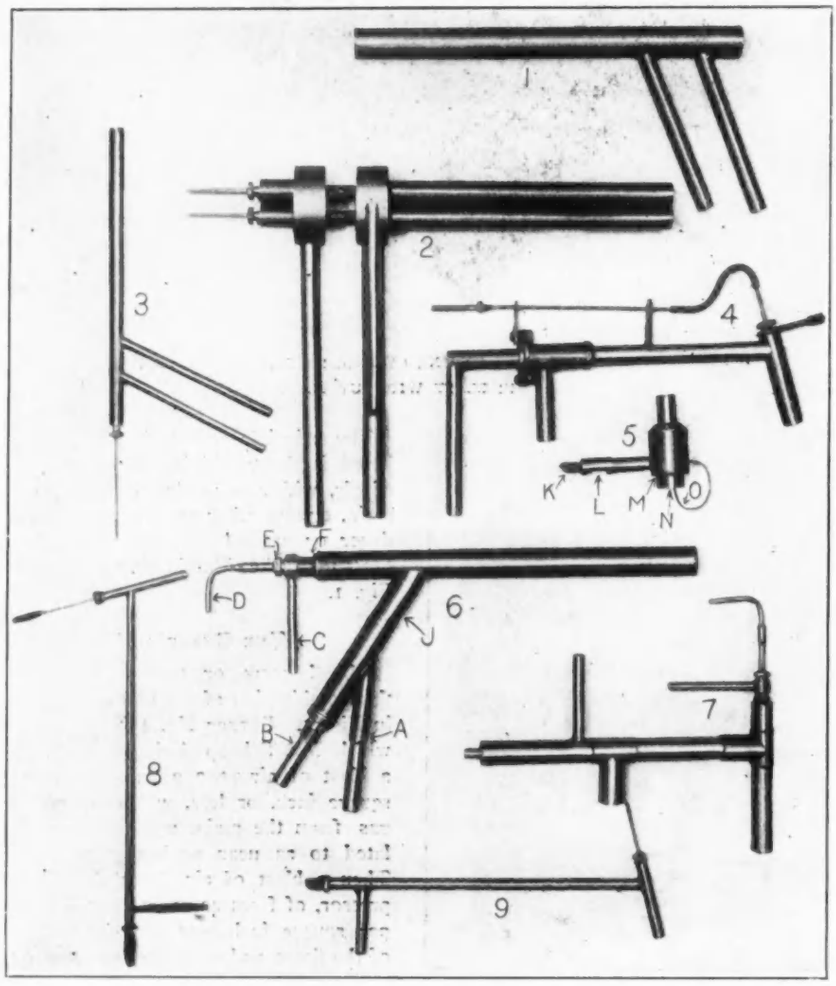


FIG. 3. GROUP OF BURNERS FOR WELDING METALS WITH ANY KIND OF GAS COMBINED WITH AIR BLASTS

### Piping and Gas Consumption

In Fig. 1, pipe *H* brings the gas from the lower floor, and this is connected to the burner with a rubber hose; pipe *G* brings up the air supply at a pressure of from 1½ to 2 pounds; and pipe *I* conveys the gas that is combined with the air, from the air compressor, at a pressure of from 40 to 60 pounds. On top of this pipe will be seen located a pressure gage.

Burners 4 and 7 are earlier designs of the type of burner shown by 6, 4 being designed for a combined brazing and welding burner. Number 2 is a multiple burner designed for heavy duty, that needs a large volume of heat. It has four burners joined together. Burner 5 is the crude burner that suggested the principle on which the others are based. It takes in gas, from the city main, at *K*, and air, at atmospheric pressure, is taken in at *L, M, N* and *O*. The flame which comes out of the top is about 1 inch in diameter at the bottom, and about 2 inches high, and it will melt a brass rod.

The gas consumption is very low and it is claimed by Mr. Schaap that the burner is so arranged that it combines the gas and air in such a manner that the gas is throttled until all the heat units are used up in their strongest form. This is done by the inside core of gas and

high-pressure air being surrounded by a low-pressure air blast united with burning gas, and this forms a cage over the center core similar to the Welsbach mantle that is put over an ordinary gas jet.

### The Work Done

Some of the work which has been done by this process shows an improvement over other methods of welding. One of these improvements, and an important one, is that cast iron and aluminum can be successfully welded without the use of any kind of a flux.

The Knox gasolene engine cylinder shown in Fig. 2 was welded with this process. This was photographed just as the weld was completed and before it was chipped and filed down to a smooth surface. The weld is shown by the rough metal at the compression-chamber end of the cylinder and it will have to withstand the pressure caused by the explosion of the gases.

The 6-cylinder automobile engine crank case shown in Fig. 4, is a sample of the autogenous welding of aluminum that was done by this process. Welds were made on this, on the lines *A*, *B* and *C*, and both of these jobs were welded without a flux.

Another interesting job of aluminum welding was done while I was an onlooker. This was an automobile, transmission gear case which had an oval hole broken out of the side, that was about 5 inches long and 3 inches wide. A copper plate was fastened to the inside, to preserve the inside contour, as a steel plate, which would have been much better, was not handy. Scrap aluminum metal was then melted on top of this copper plate, spread out ¼ of an inch thick and fused with the metal of the case. The joint was perfectly tight owing to its being one continuous piece of metal. Several cracks were then operated on by melting the metal around them and fusing other metal with the metal of the case, to close up the opening. The fact that the copper plate was not melted through in any place while melting aluminum on top of it to the depth of ¼ of an inch shows that the heat can be localized in any spot desired by the Schaap process of welding.

E. F. L.

## A Few Kinks in Structural Iron Work

By Ethan Viall

There is no class of work which calls for more brains and ingenuity than that of heavy structural iron or bridge work. The shaping, moving or placing of heavy masses of metal, to say nothing of the original designs and calculations, call for the highest class of engineering skill backed by long experience.

A short time ago, through the kindness of Superintendent Caldwell, I had the pleasure of going through the shops of the Decatur Bridge Company, and taking a number of photographs and obtaining some information and data that I believe will be interesting to readers of the American Machinist. Not long ago this company received orders for a number of turntables of the type shown in Fig. 1. The circular frame shown resting on the rollers was to be made of 24-inch I-beams. The diameter of the circle was

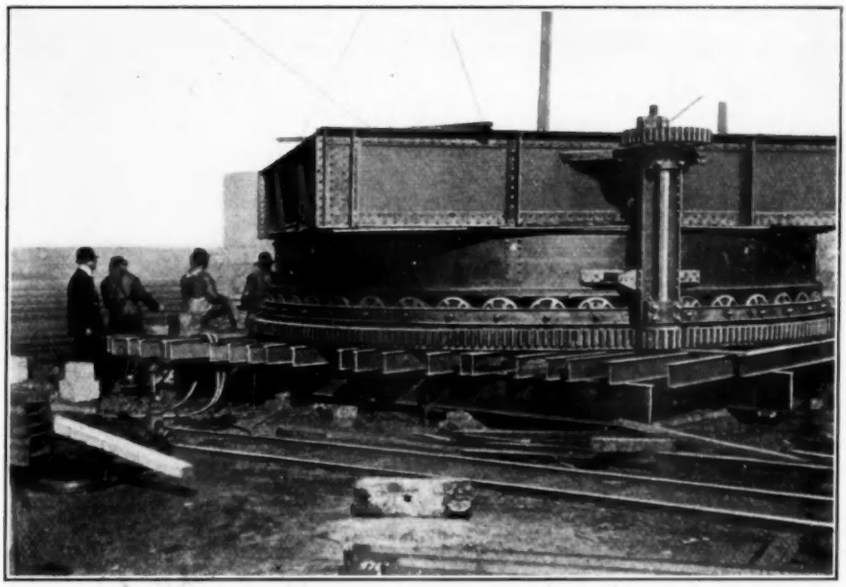

FIG. 1. A LARGE TURNTABLE

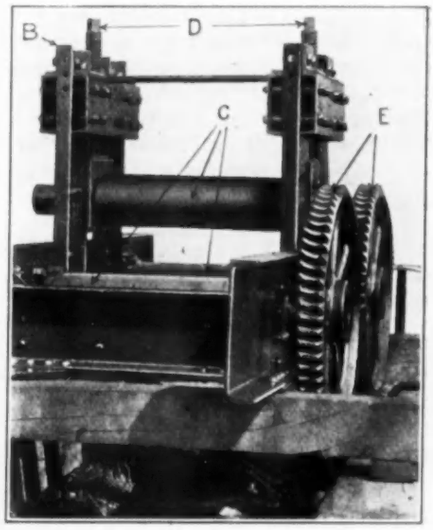


FIG. 3. ANOTHER VIEW OF THE BENDING MACHINE

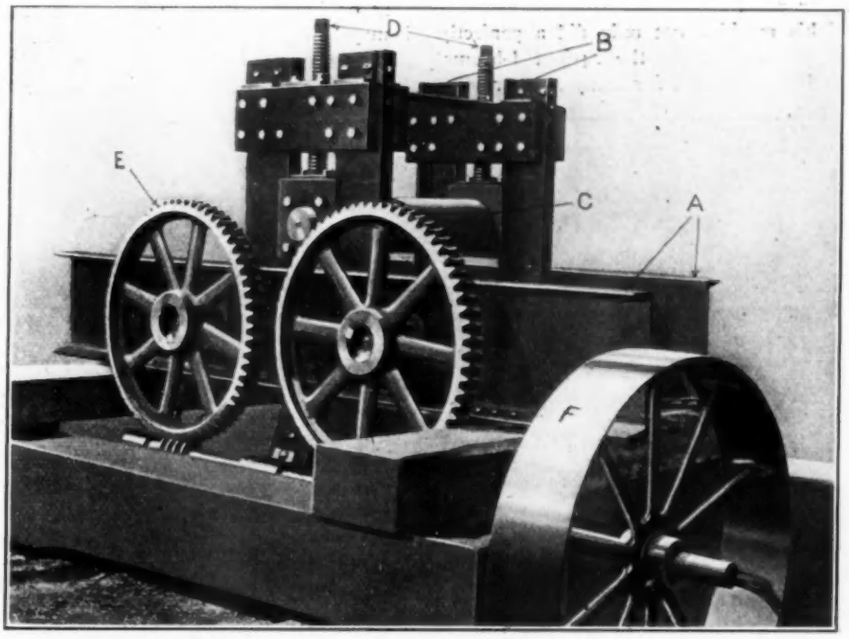


FIG. 2. MACHINE FOR BENDING CIRCULAR FRAME OF TURNTABLE

to be 20 ft. It was decided to make this circular piece in four sections, each section to be 18 ft. long. The superfluous length was to be trimmed off after bending. The idea was that this extra length would enable them to get a good bend in the length of the piece wanted and allow the ends of the sections to be fitted together nicely.

As no bending machine in the shop was powerful enough to bend these I-beams, they designed and built the bending machine shown in Figs. 2 and 3. The base or main part of the frame *A A*, is made of two pieces of 15-inch channel iron. The uprights *B*, are 8-inch channel iron. The bending rolls *C*, three in number, are

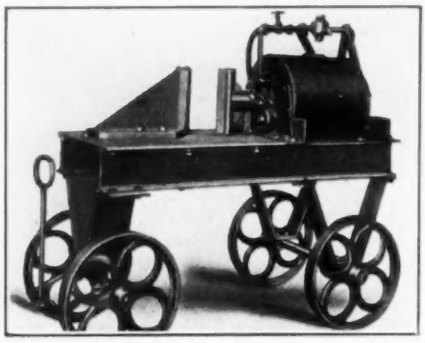

FIG. 5. A PORTABLE BENDING MACHINE

7½ inches in diameter and 28 inches long, exclusive of the bearings. The bearings are 4½ inches in diameter. The upper roll is adjustable by means of the screws *D D*, and has a vertical movement of six inches. The lower rolls are set 36 inches from center to center and the lowest point at which the upper roll may be set is 10 inches from its center to a line drawn between the centers of the lower rolls. The worm gears *E* drive the two lower rolls.

This machine not only did a perfectly satisfactory job on the 24-foot I-beams, but has been used for many smaller jobs.

In bending the large I-beams the machine was laid on its side.

After bending and putting the I-beams together, some means of planing the surfaces coming in contact with the rollers had to be devised. The arrangement shown in Fig. 4 was used. A special rack cast in sections was made and planed on the upper edge. These were then bolted into position and carefully leveled. The movable framework was made and pivoted at the middle of the table. The outer end was held by two shoes running on the upper edge of the rack. A 24-inch planer crossrail was bolted into place to hold and operate the cutting tool. This traveling carriage was moved by the motor operating through the bevel gears connecting with the pinion engaging the circular rack. This made a very satisfactory "boring mill."

Fig. 5 shows one of the most convenient angle-iron or corner-strap benders I ever saw. It is simply an old discarded compressor cylinder rigged up and mounted on a home-made truck. In this way the machine may be moved close to any of the forges and connected with the air supply by means of a hose and is ready for use.

## New Malleable Copper Alloy

Among the various malleable copper alloys, such as Muntz metal, Eich metal and "sterro-metal," which are on the market, there is one which seems to have many excellent properties in the line of malleability and ease of casting: "Ogala metal." At red heat it is highly malleable, is very hard and tough, but affords no difficulties in working. Its hardness and toughness increase up to a certain degree, the longer it is worked under the hammer or in the rolls. In a red-hot state it may be rolled to the thinnest sheets. A great advantage is its low specific gravity. Its melting point lies between 950 degrees and 1000 degrees Centigrade = 1742 degrees and 1832 degrees Fahrenheit. Its shrinkage in casting is but slight—about 0.2 to 1 per cent. When care is used, it may be cast with success. It is melted in graphite crucibles and poured when quite hot, but should not be overheated. During the melting process it should be well stirred; and in order to prevent loss in melting should be covered with charcoal powder. A slight quantity of ammonia serves to clear it in the crucible. In remelting, at least a half—and better still two-thirds—new metal should be added. It may be heated, for forging, in any fire. It is made by Herr Louis Ebbinghaus in Hohenlimburg, Westphalia.

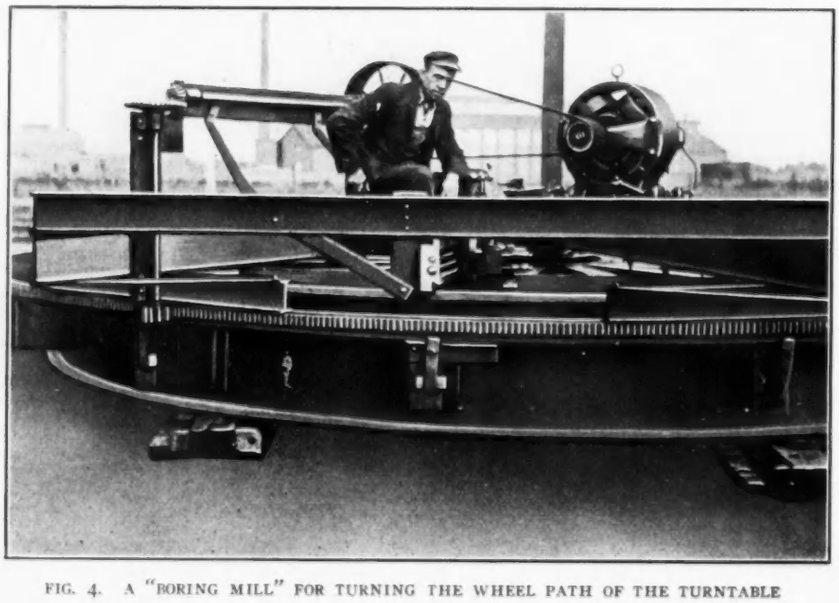

FIG. 4. A "BORING MILL" FOR TURNING THE WHEEL PATH OF THE TURNTABLE

## Some More Antique Machine Tools

By E. A. Dixie

When looking for material I often stumble on something widely different from my quest, but more interesting and

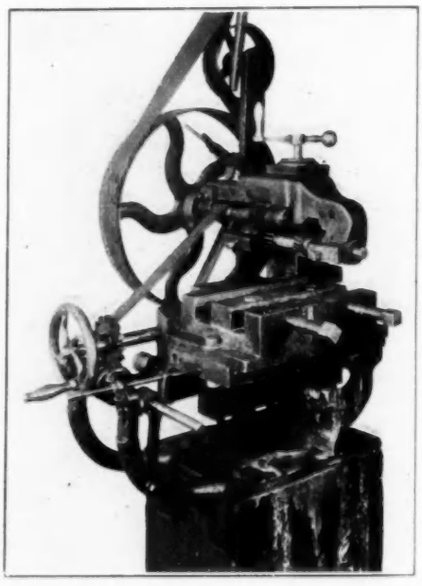

FIG. 1. THE FIRST MILLING MACHINE

valuable to me. I heard of some wonderful records that had been made in drilling small holes in tool-steel bars in the shop of the North Chelmsford Machine and Supply Company and as I was in the neighborhood I ran over to see what was being done. I had been truly informed, but I found, what was of considerably more interest to me, some of the first machine tools built in this country and still in running order. So the story of the drilling will have to wait.

The concern now builds textile machinery, ball winders and also a line of small gas engines. Formerly machine tools were built and it was one of the first shops in the country, both as regards date and quality of work. Many of the original tools have been retained, not

from any idea of sentiment, but because of economy and efficiency.

The shop was started in the early thirties I am told, but possibly my informant was wrong, for the lathe shown on page 319, part 1, Vol. 31, was planed in this shop. Baxter D. Whitney, in an interview, told me "The job was done about 1840 on a planer in North Chelmsford. The planer had cast-iron ways bolted to granite sills, the table was driven by a chain and the planer was evidently not a new one at that time." Be that as it may the shop was started by two brothers, machinists of considerable repute, from Nashua, N. H., Ira and Ziba Gay. The shop was run by water-power, and here the brothers Gay manufactured cotton machinery and machine tools. The death of the elder brother, Ira Gay, led the younger brother to look about for a competent assistant and he was successful in securing the services of Harvey Silver, of Hillsboro, N. H., who was a man of extraordinary mechanical ability, not only being an excellent mechanic, but also a successful inventor. His association with the concern in 1835, under the firm name of Gay, Silver & Co., marked the beginning of a new and successful era in the affairs of the company. On the retirement of Ziba Gay, senior, in 1857, the firm name was changed to Silver & Gay, the Gay of the firm being Ziba Gay, junior.

Under the management of Mr. Silver the shop grew rapidly and the reputation of the concern as builders of machine tools spread all over the country. After the death of Mr. Silver in 1884 the firm name was changed to Silver & Gay Company.

When the present concern, the North Chelmsford Machine and Supply Company assumed control, the building of machine tools was discontinued. A number of the old machines were scrapped, but others, whose usefulness was apparent, were retained.

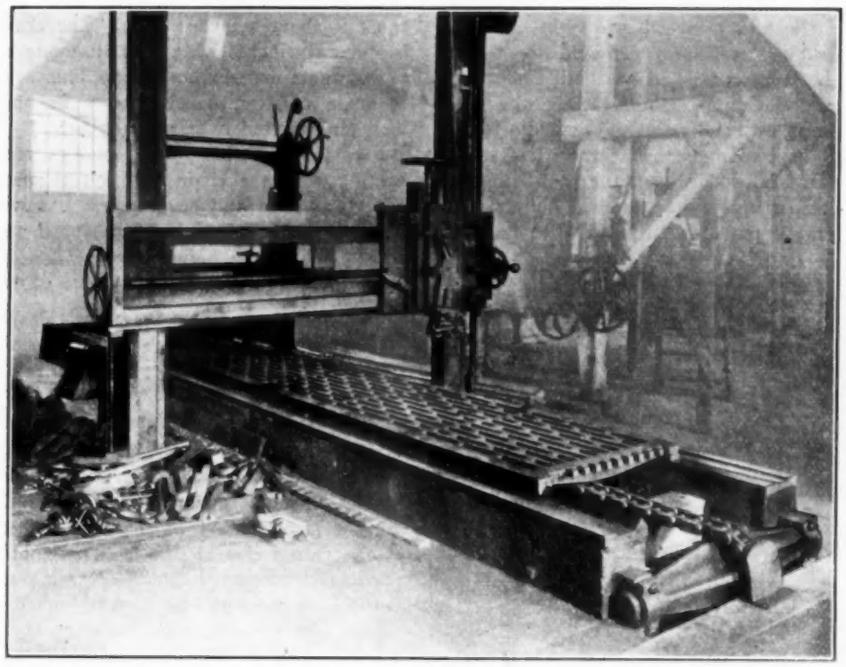

FIG. 1. FRONT VIEW OF THE OLD PLANER

Several years ago a fire at the works destroyed what was at one time the largest and most accurate division plate in the country. It was 15 feet in diameter and even within the last few months inquiries have been received by the firm for estimates on work to be divided on the "big dividing engine."

Fig. 1 shows what is supposed to be the first milling machine made in this country. It is still in use on certain small work. The base is a wooden block. Examination of the hand wheel shows that it was never turned, but has been worn dead smooth by the palms of generations of mechanics. The wooden block, as well as the machine, passed through the fire together and neither seems to have suffered in consequence.

Originally the machine had hand feed only, but some genius added an automatic feed and stop. Figs. 2, 3 and 4 show the old planer with stone sills which Baxter D. Whitney told me about. When it came to the question of scrapping this planer the decision to keep it in commission was based on actual earning power. The concern has modern planers to do the work which is turned out in quan-

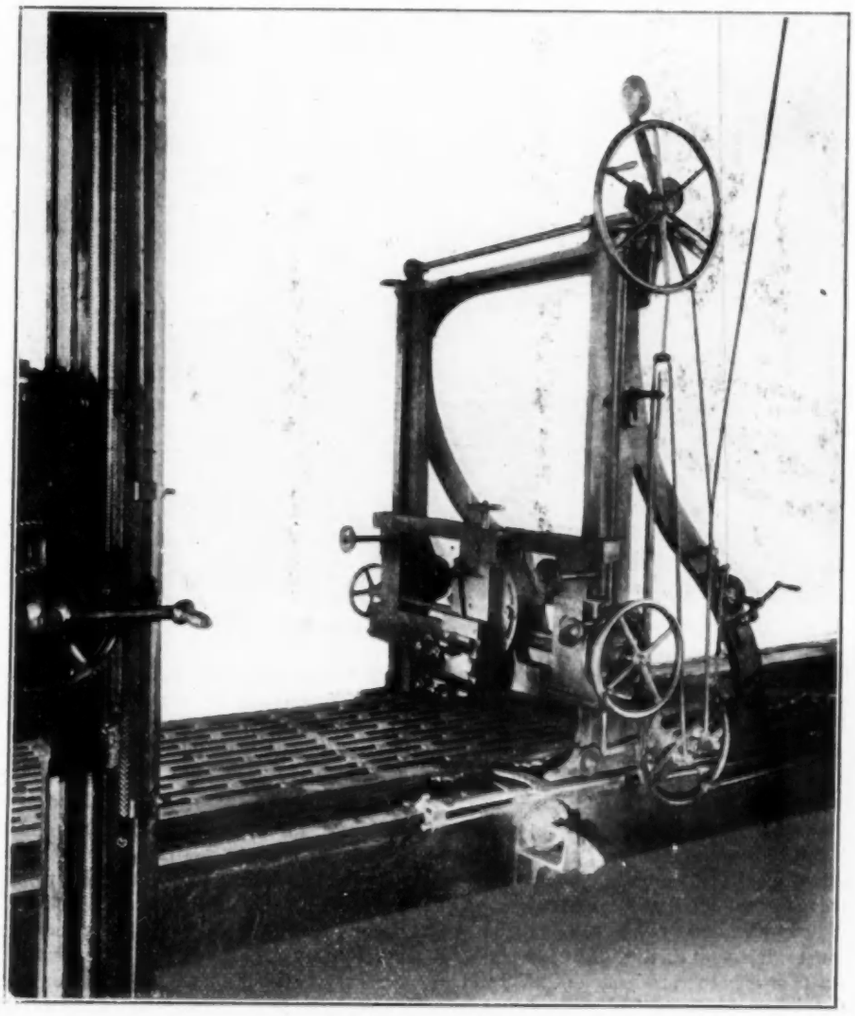

FIG. 3. PLANER SHOWING ORIGINAL HOUSINGS

tities. At long intervals a large job comes in to be machined which cannot be handled on the smaller planers. It was decided that these jobs would pay the cost of storing the old planer and a very decent profit besides.

Fig. 2 shows a general view of the large planer. It has two sets of housings, the front ones, which were added later, shown best in Fig. 2, will take 84 inches square, while the smaller ones (which were the original ones) will take 42 inches square. The table is 39 inches wide by 12 feet long. The smaller housings are distant six feet from the larger ones. The bed of the planer is of granite with cast-iron strips bolted to it. The track on one side is an inverted V and on the other flat. I think it will be admitted that this is not bad practice now and is, I think, the way some of the best cylindrical grinders are built. The ways were chipped and filed to straight edges. Obviously the one V was adopted, not because it was better, but because it was easier to produce one V and a flat track in line, than to produce two V's and to have them in line both ways. The crosshead on the small housings is elevated by two right-hand screws with bevel gears and pinions; the large crosshead by right- and left-hand screws on the tops of which are right- and left-hand worm-wheels actuated by worms. The large crosshead has both power- and hand-elevating devices, while the small one is by hand only. The saddle is held to the cross-head by a heavy leaf spring.

In Fig. 3 is shown the tool-lifting device, for this old fellow was built with an arrangement for lifting the tool on the back stroke, and although it is not used now the parts are all in place. The lever, in front of the tool slide (in Fig. 3) inclined to the left and having a horizontal handle on it, has at its other end an eccentric. A rope passes over the grooved pulleys at the sides of the crosshead. The middle of the rope is attached to the lever referred to, one end is attached to the feed-wheel and the other end has a weight attached to it. As the bed reverses the lever is pulled over and the eccentric lifts the tool, at the next reversal the feed-wheel moves, allows the weight to pull the lever over and the eccentric moves the tool to cutting position again. The inverted V track is formed at an angle of about 80 degrees with a base of about three inches. The flat track is about 3 inches wide. The chain is about six inches wide over all, made up of alternate narrow and wide links. It is made of ⅞x1¾-inch iron with one-inch pins riveted over on each side.

Fig. 4 shows the driving pulleys connecting with the chain sprocket through a vertical shaft and bevel gears. As will be seen the two-belt drive was used, the return being at a higher speed.

My next article will show some of the other tools.

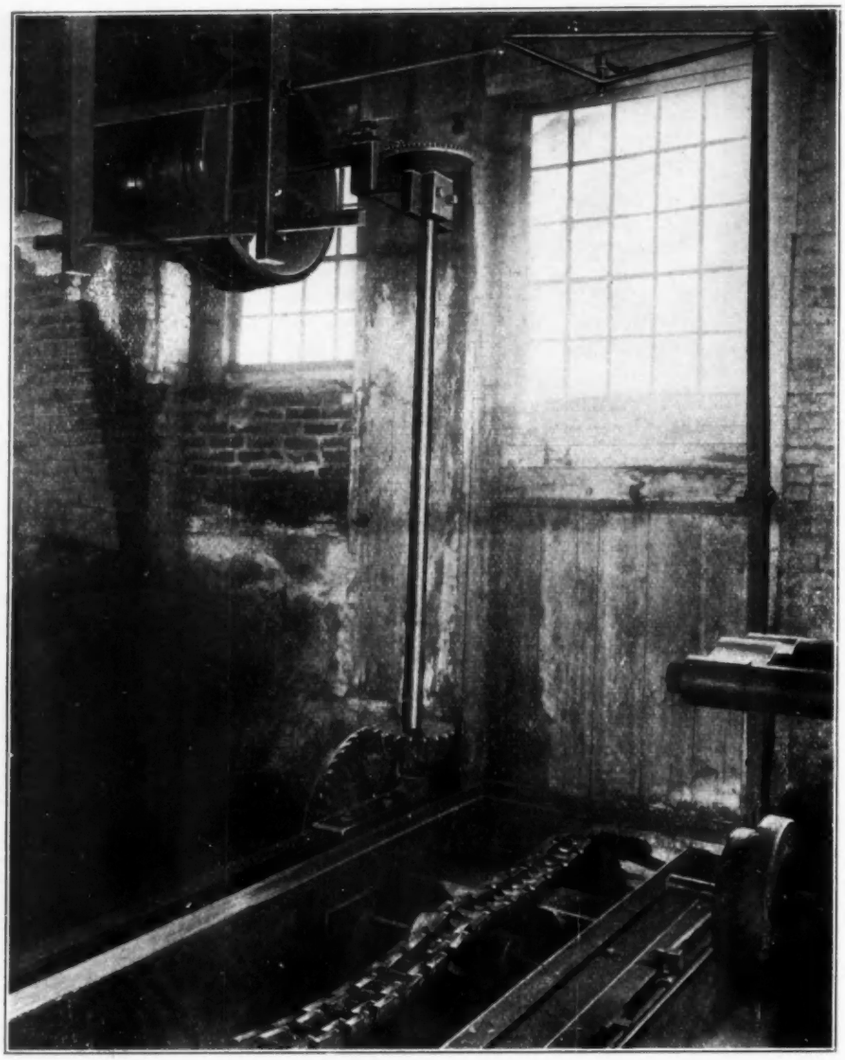

FIG. 4. SHOWING THE DRIVE

## Questions for the Designer

By E. M. King

Why are the handles on handwheels and ball handles made so that the handle rotates in the hand of the operator instead of on a central stud? This applies particularly to the handles operating the vertical movement of milling-machine tables where considerable exertion is required to move them and which on many occasions have to be used continuously.

Why are milling-machine vises made as shown in Fig. 1, with a square corner at *a* thus often making the use of small end mills very difficult? Is there any objection to removing this corner as shown by the dotted lines?

Why is the handle on such a vise made a loose fit on the squared end of the clamping screw without any means of holding it on so that when the machine starts to cut, if the vise is in the position shown in Fig. 1, the handle usually falls from the vise and makes a dent in the scraped surface of the top of knee?

I do not advocate permanently attaching the handle but some kind of a spring catch to keep it from so easily falling off.

Why are the vernier scales on milling-machine tables, as furnished by the makers, arranged as shown at *A* Fig. 2 instead of as at *B* which shows an arrangement in use in the shops of the Taft-Peirce Company, of Woonsocket, R. I., for the past fifteen years? This arrangement permits a more accurate setting and is far more convenient than that shown at *A*. Here we can look along the lines of the vernier instead of on top of them.

Is it not possible for milling-machine makers to agree on some standard dimensions for the T-slots in the tables? In the shop where I am employed are three makes of milling machines, universal and plain, of the sizes Nos. 1, 1½ and 2 and although all have ⅝-inch slots and use ⅝-inch bolts, the part of the T-slots in which the bolt heads fit is of different dimensions in the three makes. If only the regular attachments belonging to those machines were used on them this would not matter so much, but when there is a variety of jig, fixture and special

machine work to be strapped on the table, it causes much annoyance not to be able to use the same bolts in all machines.

Why do some lathe manufacturers hold the ball handle on cross-slide screws and other places by a nut of the shape shown in Fig. 3 when one a third or fourth of the thickness would answer the purpose, look more mechanical and not rap the machinists' knuckles?

Why do some lathe builders stamp the number of teeth a change gear contains, with small figures in the hub of the gear? This usually necessitates removing the nut and collar holding the gear on the lead screw in order to find out what gear it is. When simple gearing is used as is generally the case the figures are completely covered by the collar being placed between the gear and nut. In compound gearing the nut is next the gear and does not quite conceal the number, though it may be difficult to read it. Other makers have the number of teeth in large figures on the gear arm.

Why are so many engine lathes made with such dinky little V's when it is well known that such V's show the effects of wear before the lathe is in use a month?

Why do some lathe builders still use for connecting the cone pulley to the large gear on the spindle a square-head bolt moving radially and on which we must use a wrench, while other makers of lathe and milling machines for the past 20 years have been using a pin moving axially and which is easily operated by the fingers? I wonder if those makers would buy an automobile having such a speed-changing device.

Why is the lead screw of medium size, or toolmakers' engine lathes not furnished with a graduated dial as shown in Figs. 4 and 5? It would come in useful in facing work to accurate thickness also in making distances between shoulders correct and in many other ways. I am well aware that in many lathes the lead screw is cut six threads per inch and that one-sixth of an inch cannot be expressed in decimals, but why are there six threads per inch? In such cases, in fact in most cases, I would suggest using bevel gears of proper ratio arranged like Fig. 4, the graduated dial being placed as close as possible to the right-hand end of the headstock without interfering with the movement of the carriage, and set at a suitable angle for convenience for operating and reading. My practice in facing work is to use a gear of 110 teeth on the lead screw and count each tooth as giving approximately 0.0015 movement of carriage.

I find even this scheme of so much help that I believe a properly arranged graduated dial would be much appreciated by toolmakers.

Why are so many engine lathes made without a graduated collar on cross-slide screw or with one of such small diameter as to be almost useless? Is there any objection to having one almost as large as the hand wheel or ball handle? If there is room for it to turn there is room for a large dial if placed close to hand wheel. Why are such graduated collars sometimes made so that when we feed in the lathe tool, say, 0.001 inch, according to the graduations we remove 0.002 inch from diameter of work, while in others the reading is equal to the amount that the diameter of the work is reduced.

Why are the cross-feed screws on planers and shapers not furnished with graduated collars? It seems to me that on tool work, at least, graduated collars are just as desirable on a planer as on a milling machine.

While on the subject of graduated collars I should like to ask why anyone should design one like that shown at *A*, in Fig. 6, with two zeros on the same circle such as we usually find on old universal milling machines? And why, at the present time, do some makers of millers make the graduated collars as at *B*, which is very little better?

Why are flat-top bench-lathe beds made of the proportions shown in Fig. 7, when it seems to be well known that the sides *b b* wear much faster than the top *a*, thus making the tailstock a loose fit? Is there any objection to making the surfaces *b b* a little wider as indicated by the dotted lines? Makers of the inverted V-type of bench-lathe beds use a saddle or shoe between the bed and the slide rest, of the design shown in Fig. 8, the result being the slide rest sooner or later has side play on this shoe.

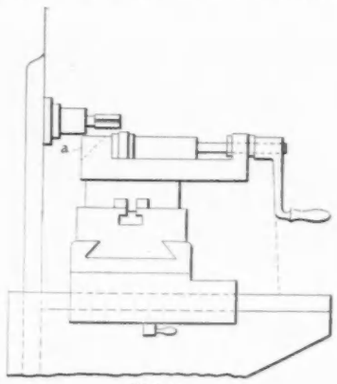

FIG. 1

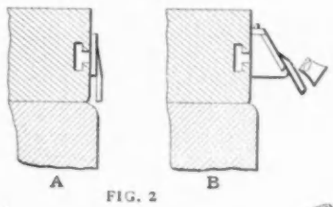


FIG. 2

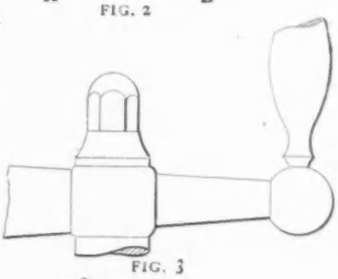

FIG. 3

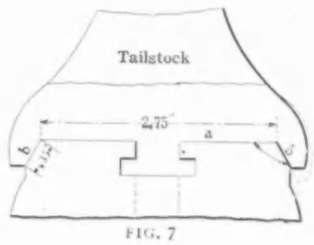


FIG. 7

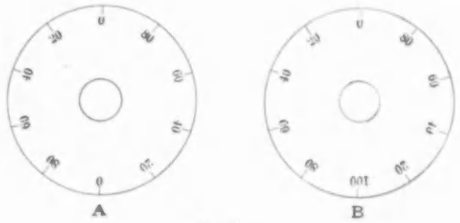


FIG. 6

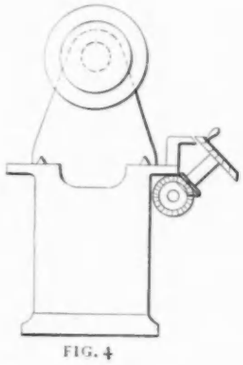

FIG. 4

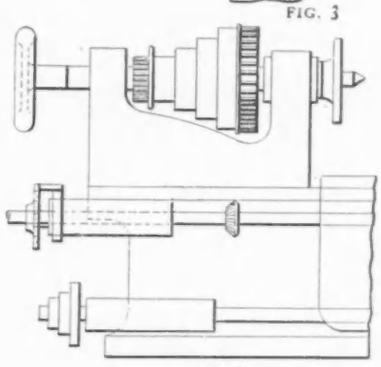

FIG. 5

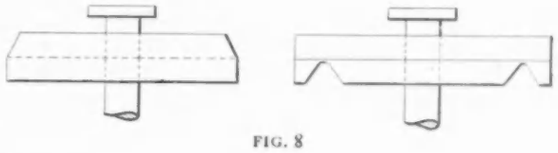

FIG. 8

POINTS IN MACHINE TOOL DESIGN

# Heat Treating Furnaces and Their Location

## The Annealing, Hardening, Tempering and Carbonizing Furnaces in the Hardening Room of the Chicago Flexible Shaft Company

## EDITORIAL CORRESPONDENCE

The heat-treatment of the metals used in building the various kinds of machines, tools and apparatus that are used at the present time, has become a very important item in the cost of manufacture and the hardening-room in most shops has been made one of the important departments.

The improvements that have been made in heating-furnaces, quenching-baths and the materials used have greatly aided in perfecting the hardening-rooms and bringing them up to a point where the operators are able to produce steels of any hardness desired and that will fulfill any of the requirements demanded of them.

When the work is of such a nature that a large part of it has to be heat-treated, many furnaces of different styles and kinds are necessary, and to arrange these furnaces in such a way that the work will be handled in the most economical manner is one of the problems of the hardening-room.

The kind of fuel to be used in the furnaces is also an important thing to be decided and where natural gas is obtainable in a goodly supply, the gas-burning furnace is undoubtedly the most economical, as it is very easy to control the temperatures and the fuel bill is low. In districts where there is no natural gas, fuel oil or kerosene can be gasified and used in many of these furnaces, by applying a special burner to them, or a producer gas-plant can be installed, which makes the fuel bill nearly as low as when natural gas is used, or the furnaces can be run on artificial gas, the latter, however, being the most expensive.

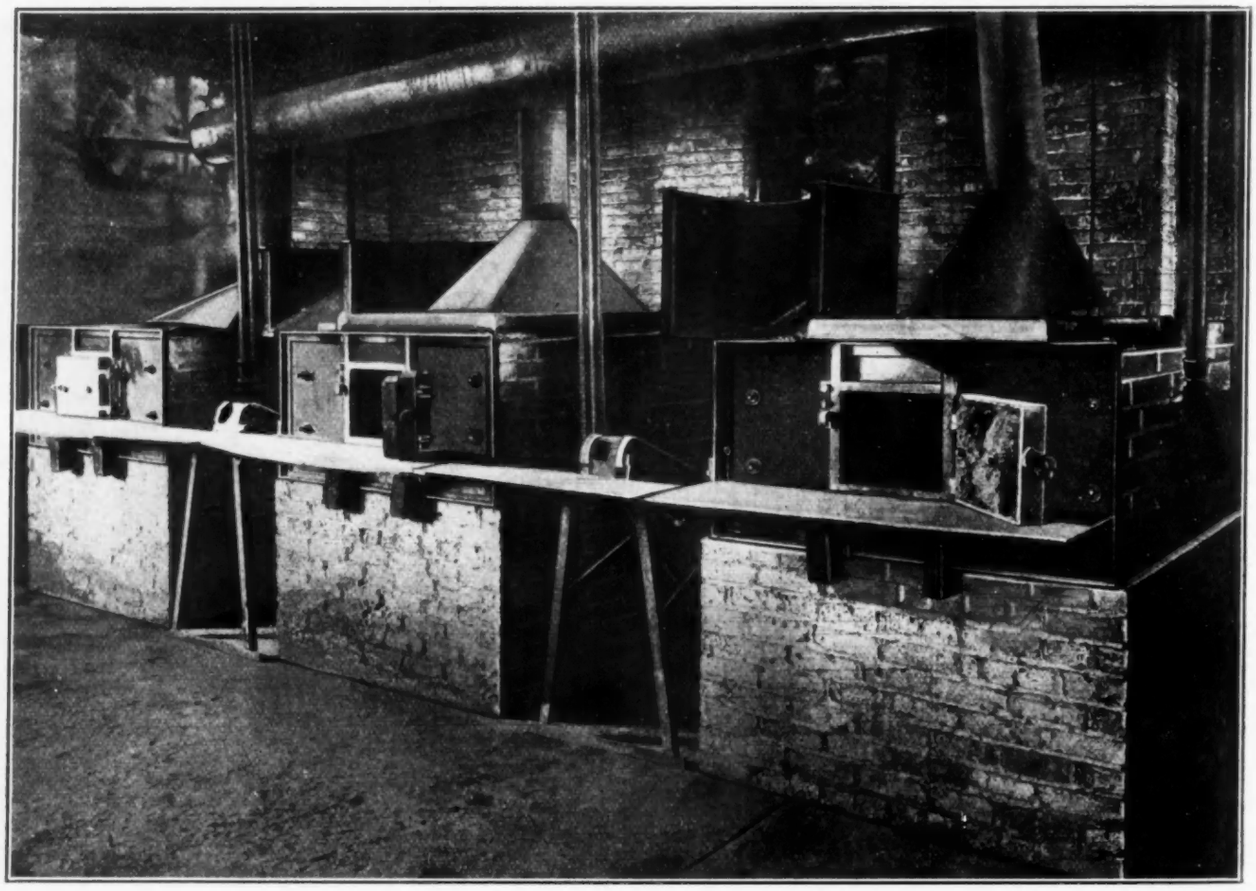

FIG. 1. THE CARBONIZING FURNACES

### Stewart Furnaces

The furnaces and forges shown in the accompanying illustrations are the Stewart gas furnaces that are manufactured by the Chicago Flexible Shaft Company. They are supplied with burners that are suitable for either natural, illuminating, producer, or gasolene gas, and for crude oil, or kerosene. These burners are located in such a way that the flames are given a rotary motion to make them encircle the gas chamber and give a uniform heat to all parts of the heating chambers, or crucibles. In the muffle and crucible furnaces, and the forges, the burners are located on the side, while the high-speed steel furnaces have the burners located on the top so as to shoot the flame downward.

The furnaces requiring it are provided with an air reservoir in the base, and a pressure blower, so as to provide an air blast which will occupy the minimum amount of space and dispense with the sheet-metal piping sometimes used. This blast effects a saving of the time used to heat up the furnace, as well as an econ

omy of fuel, and a greater cleanliness and utility is secured. This makes it possible for the operator to produce a better quality of work than would otherwise be the case. It also does away with the absolute necessity of connecting the furnace to a chimney, although it is better practice to have hoods covering the tops of furnaces and these hoods connected to a system of piping that will take the heat and foul gases away from the furnaces.

### Arrangement of Furnaces

In the hardening-room of the Chicago Flexible Shaft Company a large variety of work is handled, to be heat-treated in a variety of ways, such as annealing, hardening, tempering, and carbonizing. High-speed steel, as well as carbon steel, and some of the alloy steels, are heat-treated in this room. This brings into use a number of different kinds of furnaces and these must be placed so that the work can be handled easily and economically.

This hardening-room is located on one of the upper floors of their 8-story factory building and the floor has been covered with concrete to offset any danger of fire that might result from the dropping of hot pieces of metal on it. In the corner of the room are located the three large carbonizing furnaces with an opening between them so they can be easily relined or repaired as shown in Fig. 1.

In front of these, but not shown, are located tables on which the work, to be carbonized, is packed in its respective boxes. The carbonizing material used for packing the work in these boxes is a special composition that is made and marketed by this company. A shelf is located in front of the door of these furnaces so that the boxes can be easily and quickly handled and the furnace filled without keeping the door open any longer than is absolutely necessary. When the work is taken out of the furnace the boxes can be left on this shelf, or placed on the floor, until the work is cooled, or a tank, similar to those in front of the furnaces in Fig. 2, can be filled with a quenching liquid and placed directly in front of the carbonizing furnace door that the pieces can be hardened by dumping them in it as soon as the boxes are taken out of the furnace.

FIG. 2. MUFFLE FURNACES AND QUENCHING TANKS

### Muffle Furnaces

At the end of the carbonizing furnaces is formed an aisle, or gangway, by placing four muffle furnaces with their backs against the side of the carbonizing furnace, as shown by Fig. 2. The two end furnaces are the Stewart No. 1 oven furnace and they are designed so that a heat of 2400 degrees, Fahrenheit, can be obtained in them with an air pressure of 1½ pounds per square inch and a gas consumption of 85 cubic feet per hour.

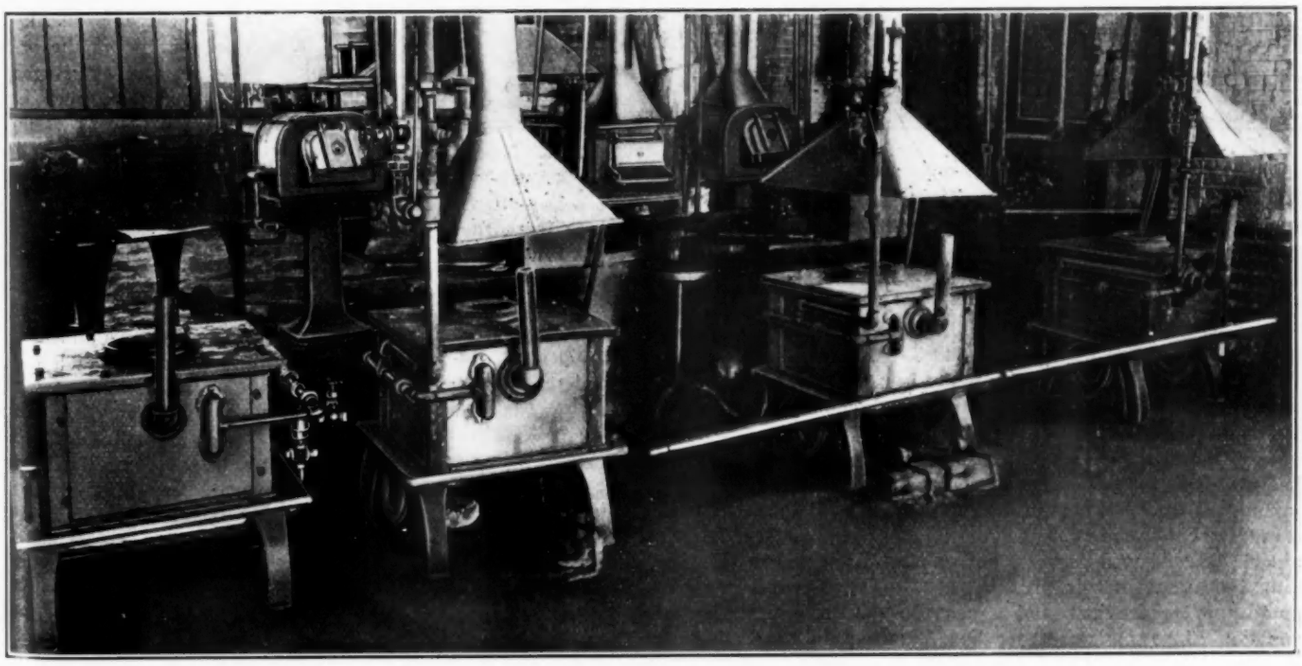

FIG. 3. CRUCIBLE FURNACES FOR LEAD BATHS, SALT BATHS, ETC.

This, however, is governed largely by the kind of gas used.

The two central furnaces are the No. 1 case-hardening and annealing furnaces, which are provided with adjustable burners so that the operation can maintain the desired temperature. The heating chamber in these is 5 inches high, 15 inches wide and 23 inches long and a heat of 2000 degrees, Fahrenheit, is obtainable with 8 burners and a gas consumption of 220 cubic feet per hour.

These furnaces are used for annealing, hardening or tempering the carbon-steel pieces which the company has to handle in the manufacture of its product and the two central furnaces can be used for carbonizing any small work which it will not pay to put in the large carbonizing furnaces, or when the large furnaces are full they can be made to take care of a part of the work.

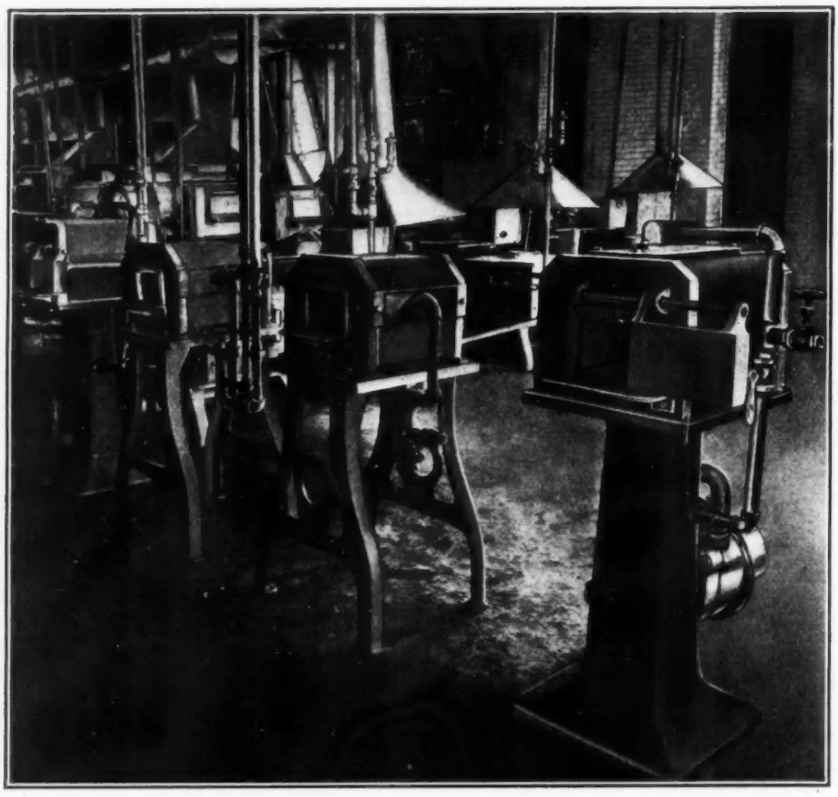

FIG. 4. GAS HEATED FORGES AND HIGH-SPEED STEEL FURNACES

### Crucible Furnaces

On the opposite side of this aisle are located the crucible furnaces, a rear view of which is shown in Fig. 3. They are fitted with adjustable burners so arranged that the flame is given a circular motion around the crucibles to insure uniform heating and they are designed for an obtainable heat of 1900 degrees, Fahrenheit, with 4 burners, an air pressure of 1½ pounds per square inch and a gas consumption of 70 cubic feet per hour, for the No. 1 furnace. Larger sizes have a corresponding increase in the gas consumption, and a poor quality of gas would also greatly increase these figures as they are secured from the use of the best gas obtainable.

In these crucibles can be used the various baths, such as lead, salt, oil, etc., that are used in the hardening and tempering of steel and as they are located directly opposite the heating furnaces, the operator has but to turn around to transfer the metal, that has been heated, to the quenching-baths. When cold quenching-baths are needed, a tank, similar to those shown in front of the furnaces in Fig. 2, can be used and the metal raked out of furnace and plunged directly into them.

With the furnaces located as these are, if the work is to be carbonized it is taken to the carbonizing furnaces, in the corner of the room, and that part of it that is to be heat-treated afterward only has to be moved a few feet to the heating furnaces. From there it is easily transferred to the various baths by the operator, until the work is completed and ready to be sent out to other departments.

### High-speed Steel Furnaces

At a right angle to aisle on which are located the muffle and crucible furnaces, the high-speed steel furnaces and forges are located, as shown in Fig. 4. The two central ones of these four are gas-heated ranges in which the required heat is quickly produced and can then be held at an even temperature. These are used for dressing the tools required in the shop and an anvil (not shown) is placed in front of the forges. They can also be used for pre-heating the high-speed steel before subjecting it to the high heat of the high-speed steel furnaces and for that reason they are located next to these.

The high-speed steel furnaces are the two outside ones in this row and they are designed to give a heat, in the chamber, of 2500 degrees, Fahrenheit, so that any kind of high-speed steel can be hardened in a satisfactory manner. As the steel handled in these furnaces is not taken to any of the other furnaces, their location is not an important factor and they can be located anywhere that will take up the least amount of floor space in the hardening room.

E. F. L.

## What's the Matter with the Plain Crank Shaper?

By A. M. Watcher

The fact that rack-driven shapers have an even cutting speed, and crank shapers an accelerating cutting speed, is often quoted to the detriment of the latter. It is also claimed that crank shapers with the "Whitworth motion" have an even cutting speed, and are, therefore, better than the ordinary crank shaper in this respect.

Now comes the accelerating cut planer. It is generally considered a good thing, under certain conditions, and its makers claim great things for it. In planer work, one obstacle to the superiority of the accelerating cut is that planer work is so often set in series, with gaps between each piece, and the tool must take the impact just the same, except when entering the first piece.

In shaper work, the piece is usually solid across the entire cut. With the ordinary crank motion the tool enters the work at slow speed, accelerates until in the middle of the cut, and then slows up in the same ratio to the end. Why cannot a higher average of speed be used on the accelerating cut of an ordinary crank motion, than on any shaper with an even cutting speed? Will someone who knows please enlighten a student?

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Due to the fact that barrel manufacture has been reduced to a cost, through the use of modern automatic machinery, that is less that almost any other form of durable packing, and is acknowledged to be greatly more convenient for handling purposes, the demand for this form of packing is greatly on the increase, and the annual production in the United States is more than 150,000,000 barrels. The enormously increased use of cement in recent years has made the heaviest demand on barrel production, while the flour and sugar industries are the next largest users.

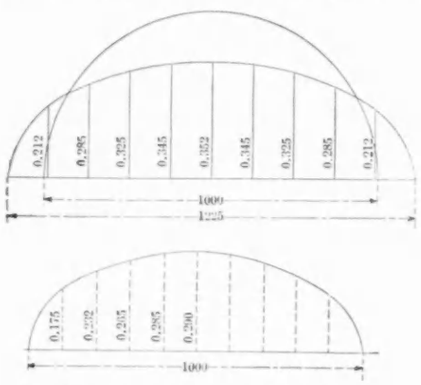
# Practical Letters From Our Readers

## A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

## WE PAY FOR USEFUL IDEAS

### The Isometrically Projected Circle

Nearly everyone who goes in for isometric projection—and the number is increasing yearly—starts in with the belief that, while it certainly is a very fine thing for builders and others who have to do principally only with straight lines,




ISOMETRIC PROJECTION OF A CIRCLE

for circles and other curves it is rather bothersome. As a matter of fact, the projection of the circle isometrically is not nearly so difficult as its representation in ordinary "artistic" or "diminishing" perspective. The "flat" circular object may be represented in outline well enough for almost any case by two pairs of approximately circular arcs; and where greater exactness is required, as where the circle is made the starting point for other lines which must "come right," the method by subdivision of original and the isometric field into small squares and lozenges, and sweeping in the lines between points determined by means of such fields, is accurate enough for almost any drawing. Should one require, however, more strict accuracy, one may also make use of ordinates, as shown by the accompanying sketches.

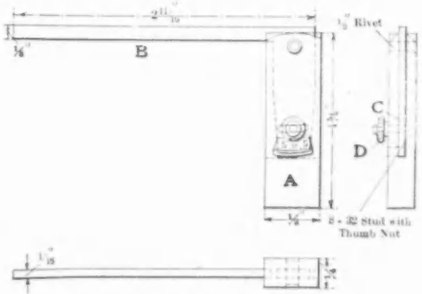
In Fig. 1 is shown a semi-circle having a diameter of 1000 on any convenient scale. Its isometric projection will naturally be an ellipse—if it is a flat circle, not the outline of a spherical object. (In isometric perspective the sphere is circular.) The major or longer axis of the corresponding ellipse will be 1225; the minor or shorter, 704. If we consider that nine ordinates, dividing the diameter of the half ellipse into ten equal abscissas or sections (each 122½), give a sufficiently fine division (there is preferably an odd number of ordinates) the central one will have a length of 352 and the others in the order of succession respectively 345, 325, 285 and 212, in each direction. This gives the semi-ellipse not merely in the proper proportions, but also in the right dimensions, to represent the given semi-circle. That is, we have not merely isometric perspective but also isometric projection, or its equivalent. If, however, the original circle be not given, and the major diameter of the ellipse be fixed, it will be just as convenient, if not more so, to consider this as 1000 (see Fig. 2); and in this case the five ordinate lengths, beginning at the one representing the semi-major axis, will be 290, 285, 265, 232 and 175, respectively. The semi-ellipse formed after these ordinates will be of the same outline as the other.

ROBERT GRIMSHAW.

Dresden, Germany.

### A Square for Die Makers

The sketch illustrates a square for die- and toolmakers' use. It is often required




BEVEL SQUARE FOR DIE MAKERS

to have a clearance on dies of from ½ degree to 3 degrees. Commercially accurate results can be obtained by the use of this tool, obviating the inconvenience of an ordinary bevel square.

Referring to the line cut, *A* is a piece of tool steel planed and ground accurately to size after being slotted to receive the blade *B*, which swings on the stud or rivet. The blade is made from 0.070-inch sheet steel, being ground to 0.0625 inch thick. The stock *A* is cut away, as shown, and graduated to 5 degrees either way, the blade projecting slightly past the edge of the slot and having a hair line corresponding to 90 degrees.

The blade is also slotted radially to receive the stud *C* which, with the thumb-nut *D*, holds it in position after adjustment. The graduating can be done accurately enough by setting to a protractor and scribing from the zero line on the blade. The dimensions and proportions of the tool can, of course, be varied at will.

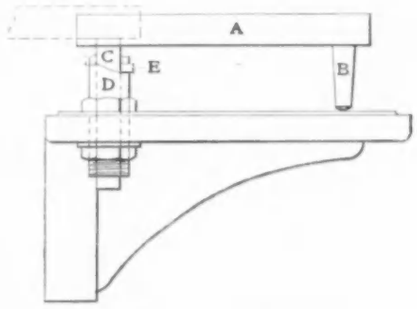
Lynn, Mass. CO-ORDINATE.

### An Auxiliary Table for the Drill Press

A job I often have is drilling holes in rectangular box castings, the holes coming on sides and ends. The jig in which the castings are drilled varies between length and breadth to the extent of three inches and, as the holes are all one size, using the same drill would require a longer travel of the drill than could be met by the drill presses installed. Owing to the position of the bushes, elevating legs on the jig would be out of question. So to meet the difficulty I made up the elevating table shown.

The drill-press table shown is bored for the steel tube *D*, which is held in position by the nut shown. The upper end of this tube is partly cut away spirally, the top end of the slope being slightly deepened. Fitting in this tube is a stem *C* carrying a hardened steel pin *E*. This stem is screwed and doweled into the circular plate *A*, which also has two legs *B* fitted to it.

The rig is so positioned that when the pin *E* is at the bottom of the slope the plate *A* is centrally under the drill and the legs *B* are in contact with the drill-press table. By swinging the plate to one side the pin *E* rides up the slope and comes to rest in the notch, the legs *B* being lifted clear of the table in doing so, thereby preventing undue wear of the table or the legs.




AN AUXILIARY TABLE FOR THE DRILL PRESS

The dotted lines show the position of the plate when not in use. By this means it will be seen that the jig is readily packed up for drilling the sides of the casting. As such a rig could be used for various drill-press jobs it could be made adaptable to various machines by having the tube *L* fitted into a C-clamp to clamp on the edges of the drill-press tables.

London, England. W. MADDISON.

## Friction Drives

The problems of modern machine design become more complex as modern methods are perfected and increased facilities for rapid operation of machinery to conform to the needs of the manufacturers are demanded.

Rapid operation and ease of manipulation with a minimum amount of noise are the essential features of any machine that appeals to the buyer. To meet this demand the use of frictions as driving members are becoming more popular each year.

The lack of time and facilities for testing frictions for their pulling capacities and proportions and the limited space for applying them often cause the designer many hours of anxiety as to the efficiency of the friction clutches he has applied to a machine.

Engineering magazines do not discuss this subject to any great extent, and there seems to be very little printed matter obtainable. To this end I have compiled a few questions which I hope will draw out a discussion of the subject for the benefit of the readers.

I believe the most common applications are those in countershafts, motor connections, geared-head drives, tapping attachments of radial drills, etc., where a band is used which is expanded or contracted by means of a key and finger operated by sliding spool or key.

1st. What relation does the peripheral velocity bear to the pulling capacity of a friction when the diameter and face and pressure are constant?

2d. Will a narrow band of a given diameter transmit the same power as one whose face is wider and diameter smaller, but whose area of contact, pressure and velocity are equal?

3d. Does the theory of sliding friction apply to driving frictions, or is the pulling capacity determined by the pressure regardless of width face, or velocity, or area of contact?

4th. What is the minimum speed at which a friction is operative for a given size and pressure?

5th. Why does a friction at high velocity transmit more power than at slow when all other conditions are the same?

6th. Does the momentum of friction band and drive plate have any material influence over its pulling capacity?

7th. Are there any reliable formulas for the proportions of driving frictions, speeds of same and pressure per square inch of contact to deliver a given horsepower?

Cincinnati, O. RILEY.

## Points in Design Which Will Save Time and Cuss-Words

I often wonder whether the fellow who designed the automobile that I've been engineering around the country ever ran one, and especially whether he ever had any repairing to do on the road. If I were a dead-game sport I'd bet dollars to doughnuts he never did. Some of the parts are as convenient to get at as a certain class of mogul locomotives with piston valves I once saw on the Grand Trunk. You had to jack up the front end and take out the truck before you got the piston valve out to see how many rings were broken.

My trouble hasn't been with taking things down, though; it's putting them back that bothers me. Among the other contraptions underneath the buzz wagon is a forked bearing something like *A* which holds two levers *B* and *C* when the innocent looking pin *D* is in place and prevented from shaking out by the spring cotter *F*. They look innocent enough when they are together, but there's more deviltry in that joint than there ought to be in a whole car, when anything happens that you have to take it down, especially out on the road.

The thing had to come down the other day out on a nice dusty road with the sun working overtime on the heat unit proposition, and getting the cotter and pin out was a cinch, but say, when I'd jiggered the parts so they were ready to go back and do business my troubles commenced. Lying flat on your back in the dirt under a car, with odors of gasolene and hot lubricating oil isn't the most pleasant occupation on earth at best, but when you try to hold up two levers like *B* and *C* together and get the pin *D* in place, you're up against the real thing. There's no puggling or juggling it into place, as the end *E* is cut off square as a die, and it's a case of getting the holes exactly in line or it doesn't go in.

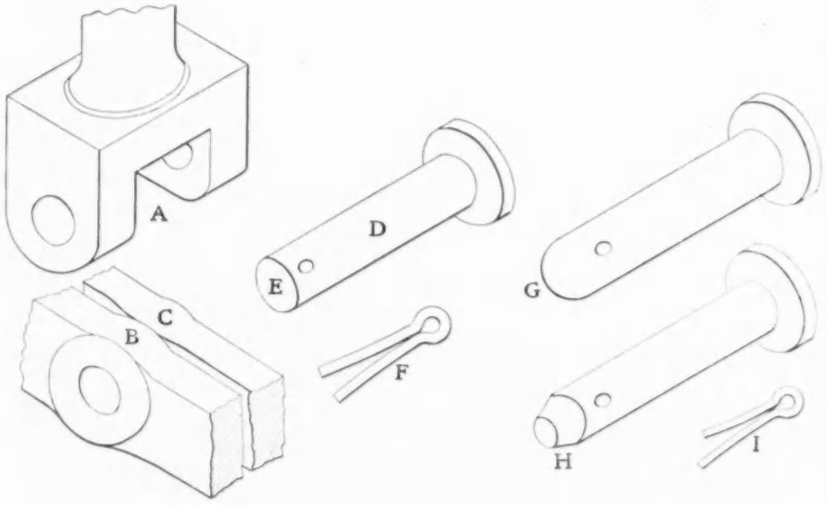
And about this time your arm that's been holding the levers up into place begins to get tired, and it's all off until you get your second wind. Meanwhile you've got an interesting and instructive audience of small boys, dogs, and any other animal that happens to be loose within two miles.

Then when you finally manage to get the pin in place through the aid of the various saints you've called on for assistance, you tackle the cotter *F* and have some more fun. Of course, it's been sprung out and the points seem to have quarreled and parted company for good. They are so stiff you can't pinch them together with your fingers, and there are many places where if you get the pliers on them you can't get to the hole. The ends are square or dubbed over, and you've got to have them both just right and even to get them in at all. Half the time you wish you had a wire nail instead of a cotter anyhow.

Now why some designer, or builder, or anyone else who has anything to do with automobiles doesn't get wise to the profanity provoking possibilities of this arrangement and cut it out in the interest of law and order or something else I don't see. Why not make the end of the pin round as at *G*, or conical as at *H*, instead of the square, sharp corner as at *E*? Then you could juggle it in without any trouble even with your eyes shut, and you'd have more good nature left to enjoy the rest of the ride.

The cotter can easily be made with one leg longer than the other as at *I*, and then it's easy to get into place. You can enter the long leg, press the short leg down against it with a screw driver, or any old thing, and push it in place without any invocations being necessary as with the other.

There are also other places in machinery of various kinds where a similar condition of affairs exists and where a consideration of the fellow who has to make repairs would cut out lots of time consum-




SOME POINTS IN AUTOMOBILE DESIGN

ing annoyance which is entirely unnecessary.

New York, R. E. MARKS.

## Wabbling Cold Saws

We had a great deal of work for the cold saws, and in consequence they were rushed to their fullest capacity. Then the trouble began; saws would seize in the work and cause delay. I hit on the scheme of putting washers on the saw spindles which would throw the saws out of truth and make them cut a kerf wider than the saw. A saw 2 feet diameter and 3/16 inch thick was thrown over so that it cut a 5/16-inch kerf.

The results were surprising. Saws which were badly worn when used in this way absolutely refused to seize, the cuts were straighter, and less stock was wasted.

London, England. J. T. TOWLSON.

## Some Prehistoric American Small Tools and Work

A good many years ago, in the days when I thought I knew about all there was to know of the machinist's business, a job was brought to me which included among other work the drilling of some holes in a piece of ½-inch plate glass. I used the old method, a copper tube shod with emery, cutting from both sides so as to prevent the glass from chipping on the one side as the drill came through.

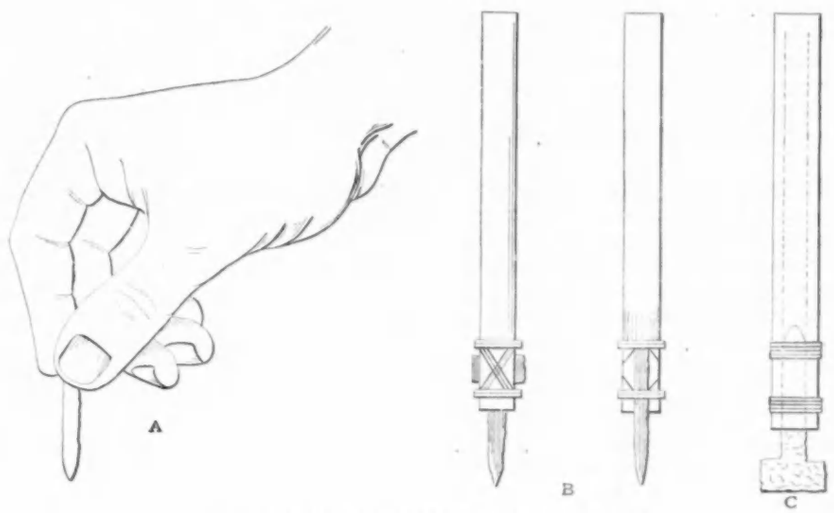



FIG. 2. THE WAY THE DRILL WAS PROBABLY USED

I was talking about this job to a man in the South recently, when I finished he said:

"The tube left a core, of course. How far back does the core drill date, do you think?"

I told him I did not know but a liberal rough guess would perhaps place it within the past 200 years.

He turned to a cabinet and handed me one at a time the tools and work shown in the illustrations, at the same time telling me what he knew about them.

These pieces were taken by him at various times from Indian mounds in Tennessee, which date back no one knows how far.

*F*, Fig. 1, shows a fragment of an implement made of a slatey sort of stone. The hole through it, 7/16x1⅜ inches, was evidently drilled from both sides with a core-drill or at least it is reasonable to think it has been done with either a core drill or a piece of wood or cane shod with sand because under the glass the grooves worn by the sand or other abrasive show very plainly.

If there were any doubt in my mind about these Indians having used core drills (probably made of bamboo cane

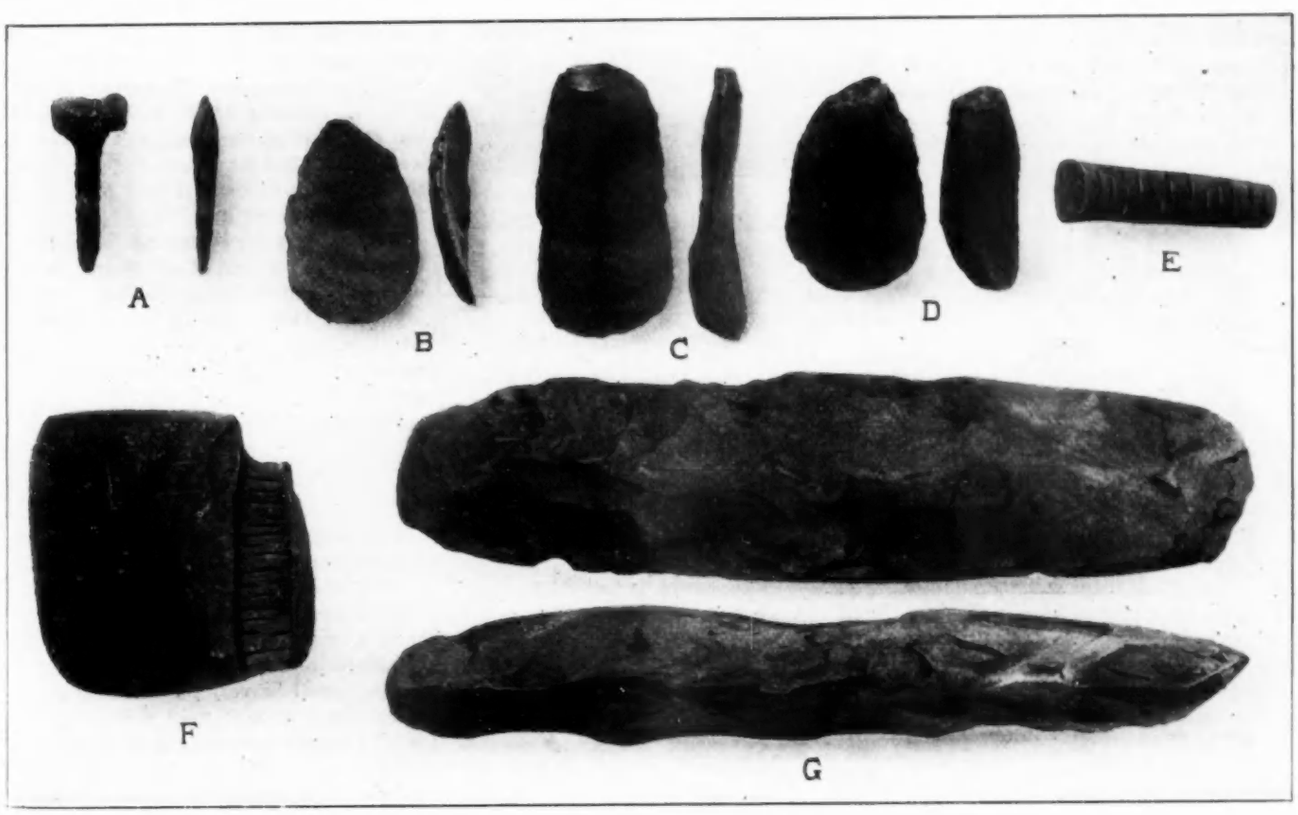



FIG. 1. SOME PREHISTORIC AMERICAN SMALL TOOLS AND WORK

which grows in the neighborhood) it would be dispelled at once by an examination of *E*, Fig. 1. This is evidently of the same material as *F*, and is a core. The grooves made by the abrasive are so deep that I expect the half-tone to show them clearly.

The reed was probably a little larger in the bore than the smallest diameter of the core which is tapered, 1⅜ inches long, ¼ inch at the small end, while at the large end, where it was broken off, it measures ⅜ inch diameter. How the reed was rotated one can only surmise. In all probability a bow was used. The tapering of the core was no doubt due to the bell-mouthing of the reed and also to a certain extent to the reed either not being straight or to its wabbling more or less.

*B*, *C* and *D* show three stone scrapers made of flint. The three are in shape almost exactly alike especially so at the lower end which is the cutting edge. What they were used for no one knows, probably to shape wood or pottery, some very fine examples of which were found in the same mound with them.

*A* shows a flint drill. This may have been either used in the hand by gripping the top in the fingers, see *A*, Fig. 2, fastened in a cleft in a stick as shown at *B*, Fig. 2, or secured in a reed as shown at *C*, Fig. 2. In the latter case a hole could be drilled limited for depth by the length only of the reed.

*G*, Fig. 1, shows a stone chisel. The cutting end is easily distinguished because it has been worn smooth by the material upon which it has been used. In shape the cutting end has been somewhat similar to what we in the shop call a "cow mouth" but the edge has been broken so that it is not sharp now.

New York. E. A. SUVERKROP.

## Wheel Puller for Automobiles

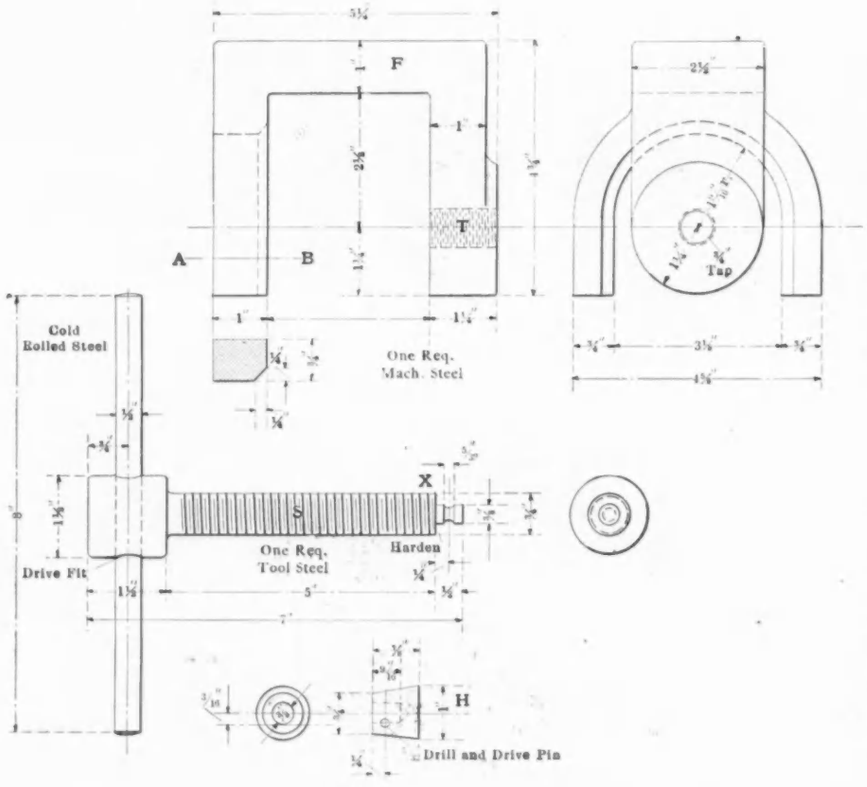
The small tool shown herewith is a very handy and useful one for the erecting room or the testing stand of an automobile factory when the wheels stick or are hard to pull off.

The forging shown at *F* fits over the projection usually found on the hub of an automobile wheel, and the screw *S* working in the thread *T* pushes against the end of the axle.

The swiveled head *H* is put on the end of the screw and the thrust of the screw comes against the shoulder *X*. The swiveled head *H* and the shoulder *X* should both be hardened.

R. B. LOVEJOY.

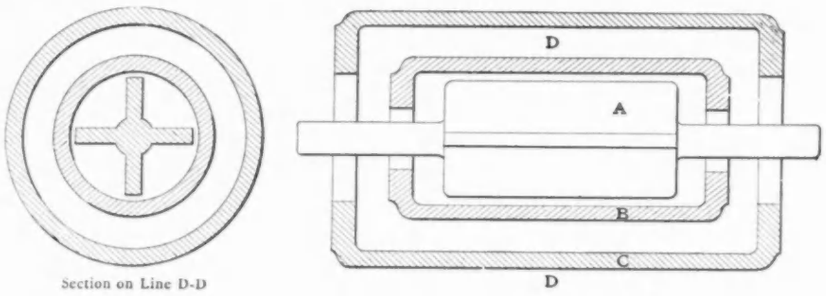
Washington, D. C.




WHEEL PULLER FOR AUTOMOBILES

## A Peculiar Pattern

While working in a job shop a customer brought in drawings of a peculiar pattern which he wanted made so as to get some aluminum castings. The pattern is shown in the line cut, and, as will be seen, it is three distinct castings, but *A* must be cast inside of *B*, and *A* and *B* inside of *C*.




PATTERNMAKER'S DRAWING FOR A PECULIAR CASTING

In making this we made a pattern of *A* and had a casting made from it. We then made a pattern and core box for *B* and split them on the center line. The casting *A* we placed in the core box and rammed the sand around it, then parted the box, took the core out, placed it in the mold which had already been made from the pattern *B*, and cast it. This gave us the casting *A* inside of the casting *B*.

Next we made a pattern and core box for *C*, parting them also on the center line. We then placed the castings *A* and *B* in the core box for *C* and rammed up this core around the castings, after which we made a mold for pattern *C*, then placed the core with castings *A* and *B* in it, in the mold and cast it.

This gave us the completed job, with *A* cast inside of *B*, and *A* and *B* cast inside of *C*, which made it a simple but interesting one. There may be other ways in which to make this, and I think it would be educational to hear from others on this subject.

Dorchester, Mass. G. H. WILLARD.

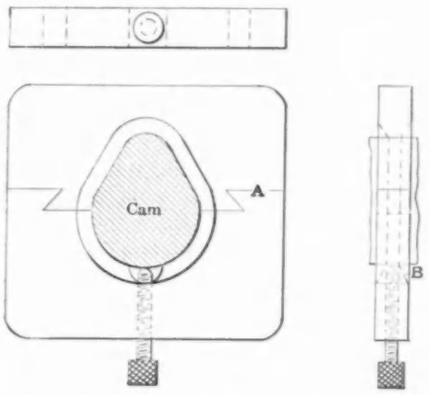
## A Hardening Kink

Heat the tool or drill until it is just hot enough to melt sealing wax. When it will do this readily give it a good coating of the wax. Heat it again until it is a bright cherry red, then quench it quickly in cold brine. A tool hardened in this way will be very hard and tough. I have seen a ½-inch twist drill, hardened in this manner, sent through a perfectly hard hand file ¼ inch thick. A center-punch mark and a few drops of turpentine were all the help given it.

Woodhaven, N. J. FERRO.

## Gage for Testing Gas Engine Cams

The gage shown herewith consists of two pieces of machinery steel machined all over and made to fit together, as shown at *A*. The hole is then made (in the profiling machine) the correct shape and the



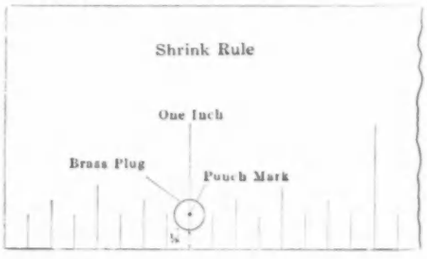

A GAGE FOR TESTING GASOLENE ENGINE CAMS

edges beveled off, seen at *B*. To use it is slipped on the cam and the thumb-screw tightened up sufficiently to hold it on. The cam-shaft is then lifted up and one looks for daylight between the cam and gage. This is a success, as it shows at once incorrect or correct shape of cam.

Grantham, England. T. A. J.

## Shrink Rule Kink

The majority of patternmakers use a shrink rule made of wood, some prefer the steel shrink rule. A good mechanic has one for the different shrinkages of ⅛, 3/16, ¼, 5/16 and ⅜ of an inch, and some




RULE WITH CENTER HOLE IN BRASS PLATE

now have 1/10 and 1/12 of an inch. They have a source of pride in the good care of them and nothing is more annoying than to see a new accurate rule destroyed or disfigured by the divider, compass or trammel points.

To overcome this bad feature, also to insure accuracy I have a brass plug inserted in all my rules at the inch division, ⅛ of an inch from the edge of the rule, as shown in the illustration. In this brass plug is a prick-punch hole accurately marked at the 1-inch division. When setting the dividers, etc., the point of one leg is put in this punch mark, the other leg set to the required dimension, always remembering that you have advanced one inch instead of at 0. Another good point about this is, since putting on this improvement I rarely ever make a mistake in setting my scribers. I have also inserted this plug in all the triangle scales in the drawing room. Use a brass screw for the plug.

Beloit, Wis. M. EGGARD.

## A Break from Initial Strains

The accompanying illustrations, Figs. 1 and 2, are of interest as a good example of initial strains in castings. The casting came in from the foundry on a Saturday and was taken to the lathe and laid there until the following Tuesday morning. It was then put on the face-plate and bolted down on three points by 1-inch bolts.

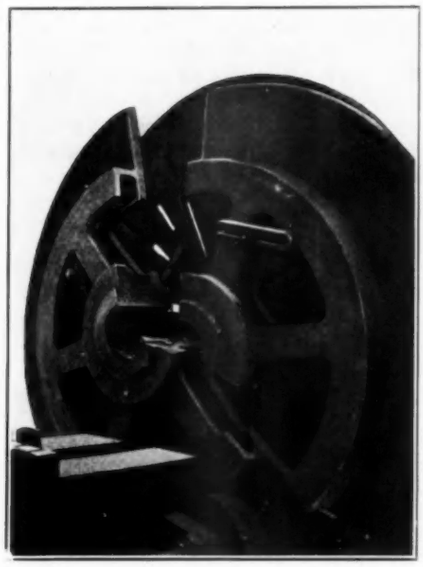


FIG. 1. A CASTING BROKEN BY INITIAL STRAINS

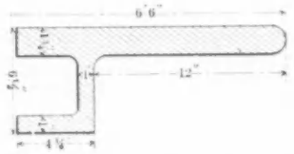


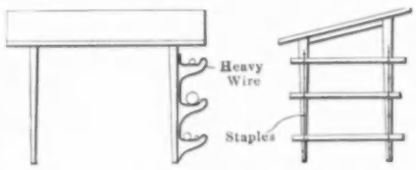

FIG. 2. SECTION OF CASTING AT BREAK

When in position it was perfectly sound, as it rang true when tapped with a spanner. It was intended to be set by screw dogs which had to be bolted to the face-plate, and which could not be put into position until the casting was on the plate. A final wrench was given to the holding-down bolts, the gantry taken away and the dogs were being prepared, when with a crash the casting fell in two pieces. It will be seen that there are three parting pieces in the boss; but the outside ring is continuous. There was no sign of a flaw anywhere in the break. The weight of the casting was about 2800 pounds. No one was hurt.

London, England. NEMO.

## Table Rack for Drawings

The appearance of many small drawing rooms is often marred by carelessness in scattering around prints and layouts, which a draftsman needs for reference, but which are not in constant use, making it necessary to pile them on the floor



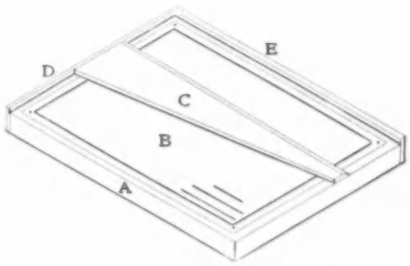

A TABLE RACK FOR DRAWINGS

if the size of the drawing table is that which is usually found. A handy device to overcome this trouble can be made easily with some heavy wire and a few staples, by bending the former into a series of large hooks and stapling the wire thus formed to a leg of the table. Two legs so equipped make a good substantial rack, on which reference prints and drawings can rest within easy reach of the draftsman.

Davenport, Ia., A. K. READING.

## A Drawing Board for Small Details

The sketch shows a handy little detail board which has been found very convenient in detailing automobile parts, etc. It may be made of good pattern pine, making all corners at right angles.




A HANDY DRAWING BOARD

Two strips *D* and *E*, about 3/16 inch thick, are glued and nailed to the left-hand and upper edges. These serve as a guide for a triangle *C*, also of wood, or any other suitable material.

Working to the right, *C* may be allowed to guide on *E*. Working to the left, either *C* or a small 30-degree triangle may be used. This dispenses with a T-square, thereby trading two joints for one.

The sketch shows a board 9x12 inches inside of strips *D* and *E*.

Elyria, Ohio. V. P. CRAMER.

# Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

## WE PAY FOR THESE ALSO

### A Successful Suggestion System

In an editorial, on page 392, there is recorded the fate that many of the suggestion boxes fall heir to. I cannot, however, let the matter drop without making known to those interested a case that has not allowed the disconcerting, irrelevant features, that always creep into new schemes, to destroy its usefulness.

The manager of a large shop in the South, where cotton-gin and hydraulic machinery of all kinds is built, decided to give the suggestion system a trial. After the usual discussion decision was made to have a copious blank for these suggestions. Spaces were left for various items, as to the operation, drawing numbers, numbers of pieces affected, and other things that those drawing up the form could account for in the necessary operation of the plant. The forms were then placed in the general foreman's office, so that all workmen might have access to them without difficulty.

When a machinist had an idea he wrote it as best he could, and turned it over to his foreman; the latter, in turn, was supposed to make recommendations and remarks upon it and pass it to the general foreman; after his impressions were recorded as to its worth, it went to the superintendent, who likewise criticized. With these manifold cuffs and earmarks, it was finally handed to the committee for action. It is not difficult to realize the outcome of such routine. The first bad feature was the time element. The rush of business and natural disinclination of foremen and superintendent to pass and definitely decide in writing on something that might be entirely overruled by authorities above, caused the paper to drag, and in some cases it developed that a month, or six weeks passed before a suggestion finally made its way through so many hands. Naturally, the originator felt slighted at the delay, and often the chance for a saving had passed by the time action was taken.

Then militating against it were the petty jealousies and discriminations of foremen and general foremen, who, when unthrottled, work to the detriment of the underman and his ideas.

Thirdly, after putting in a suggestion, the criticism of his immediate superior was never known to the suggester; nor was any provision made for returning to him his paper with a clear, concise reason as to why it had not been accepted. One of the killing features of any scheme of this kind is that the men soon begin to feel that their suggestions are not looked at or considered. This belief will stop the flow of ideas ten times sooner than a rejection; that shows them consideration has at least been paid for their trouble and interest in the concern. Fourthly, no direct and immediate compensation was made when an idea was accepted. Of course, a man likes to see his scheme put into operation; but how much harder will he think and work for a good saving in the shop operations, if he is morally certain that a certain per cent. of that saving is, first of all, coming into his pockets?

So this system of suggestions fell of its own weight. The manager of the factory, however, believed the idea good, but the execution, faulty. He began to analyze the proposition with about the above conclusions as to the cause of failure.

#### The Second Scheme

After some consideration, another scheme of operation was successfully hit upon, is now active, has caused the development of many good and valuable ideas and has obtained splendid results. It is substantially as follows: The old blanks or forms for making suggestions were eliminated as inadequate. In each section of the factory were placed locked boxes with entrance slots and on the box were printed instructions which outlined the fact that suggestions were solicited by the management, to be written as one chose and with any convenient materials, giving drawings, numbers, etc., when possible. The boxes are emptied three times a week by the manager's clerk. All suggestions are taken by him to the office and a suitable record made as to the man, date, section, suggestion and, if accepted, compensation paid. These papers are then grouped according to departments and forwarded by the clerk, under the manager's signature, to the general foreman of the department in which it originates. The general foreman is instructed to take the matter up with the originator and his foreman for discussion and write out recommendations and remarks which are to be read by the man, and his own name signed to the bottom of his superior's letter. If the change involved comes within the jurisdiction of the general foreman and is acceptable, he is, of course, to put it into immediate operation. Within three days the papers must be back in the hands of the manager's clerk. If action has been taken, the papers are sent to the cost department where a man is detailed to investigate the saving incurred by the change. If the change is out of the general foreman's sphere, he makes his recommendations and with the originator's signature sends it to the clerk, who in turn forwards it to the superintendent for his action. He is to discuss it with his general foreman, and if coming under his jurisdiction, action is taken. If he disagrees with his general foreman, his recommendations are to be made in writing and forwarded to the manager, who acts personally, or else appoints an immediate associate to act.

If the recommendation is not deemed expedient, the originator is given the exact facts in the case. In all instances an endeavor is made to have him satisfied that such action is just, and that his work and thought have been duly considered.

It often happens that a suggestion may be good in view of the man's knowledge, but future extension and intended changes will make it impracticable. In such case the suggester is taken into confidence and the exact status explained to him.

The compensation that follows profitable suggestions, is a strong feature of the scheme. After a change is put into operation the cost department determines the actual saving that will result in one year, and a check for one-twelfth of this is put in the man's pay envelop as soon after as the determination is possible. The money is a company check as distinguished from the regular pay, and attached to it is a memorandum stating the management's appreciation and what the additional check is for.

This, as I have said before, I know to be a good, live plan. It is easy to see that the right method is used and that it is a successful suggestion scheme.

Wilkinsburg, Penn. F. H. Neely.

### Treatment of Blueprints which Show a Tendency to Fade

I was greatly interested in the short article by W. E. M. on page 241, under the above title, because about two years ago the firm I was with experienced exactly the same trouble, that is to say, the blueprints faded badly, but it was found that if a print was put in the bath face downward for the usual period, then taken out and allowed to dry in a room in which there was as little light as possible, this trouble was entirely eliminated, while an-

other blueprint cut from the same roll of paper, but bathed face upward and allowed to dry in a well lighted room would fade not only during the drying process, but afterward.

Chelmsford, Eng. BLUE PRINT.

## Increasing Strength of Pinions by Heat Treatment

I was much interested in the article on the hardening plant of the Standard Tool Company, of Cleveland, on page 327 of the AMERICAN MACHINIST. This seems to be as nearly perfect as money and experience can make it, and it shows that the most important part of tool making is now being recognized as vital, in this age of competition, and not left to luck. A great many have only a forge, or perhaps a gas furnace, and no pyrometer, but with a fair knowledge of steel and some judgment good results have been obtained.

An experience I had about a year ago may be of interest. We were building a special machine, of which a great many were expected to be made later. One of the most important parts was a small tool-steel pinion on the end of a shaft. Of these there were 48 in the machine. On a similar machine built the year before these were made by a well known Eastern firm, and did not show up any too strong after being in use. The pinions on the new machine were of finer pitch and shorter than those on the old one. They were 12 teeth, 22-inch pitch, and 11/16-inch face.

After getting under way it was decided to make some tests as to the strength of the teeth. We made a block, with a clamp to hold the shaft, with the pinion overhanging as in use, and then arranged a triangular, scale-edged, fulcrum as a lever, one end to bear on the pitch line of the tooth, the next tooth being ground away to make room, and a wire hook and bucket on the other end about 20 to 1. This we could load up with water, or iron, or both, and then weigh with the lever.

We then tested one of the old pinions that had been in use the year before, and it carried 1500 pounds and showed a fine fracture. After this we made up several new pinions of different samples of steel. I then took pieces of the same bars, marked them and hardened them in water at different heats, as near as I could judge by the eye, until I found the lowest heat that would harden properly and give a fine fracture. I then hardened the pinions at the same heat, and drew one to a dark brown, one to a dark purple, one to a blue, with an oil bath, and one to 580 degrees Fahrenheit. On testing these the best I could get was about 1000 pounds. I then took the same pinions, at the same heat, quenched them in sperm oil, and drew them to the same colors, with a result of 1600 pounds and over, thus beating the larger pinion on the old machine. After making several tests, on several teeth, on a pinion, I took one of the original larger pinions and treated that the same way with a result of 2000 pounds.

Afterward in hardening a lot, in too bright a light, in a blast-gas furnace packed in tubes, I felt sure one lot was made too hot, so I tested several and found they were no stronger than the ones hardened in water, and of a coarse fracture. These I reheated to a dull red, in daylight, and let them cool; when cold I reheated, hardened and drew them as before, and they showed up nearly as strong as the others, and with a good grain at the fracture; but neither strength nor fracture was as good as the ones that were not overheated, thus showing the importance of the right heat.

The steel used was a special brand of annealed carbon-tool steel at about 8 cents per pound, and it took 48 pieces, 26 inches long by 11/16 inch diameter for one machine.

Pittsburg, Penn. THOMAS A. DICKS.

## The Nozzle That Does Not Splash

Referring to the emery-wheel nozzle that does not splash, as described at page 356 I venture the assertion that the explanation is as follows: The revolving wheel produces a partial vacuum just behind and immediately below the end of the nozzle, by driving the adjacent particles of air straight downward or tangent to the wheel at this point. Other particles of air rushing toward this vacuum impinge upon the intervening water issuing from the nozzle, and drive it against the wheel.

GLENWOOD MACOMBER.

Wanamaker, Ind.

## Testing Turret Lathes for Alinement

In one of the back numbers of the AMERICAN MACHINIST, a correspondent described a method of testing turrets for alinement, when the work turned out by them would not come up to the standard of accuracy required. His method, by scriber point and a plug in the tool hole of the capstan, is a method often used in England for adjusting them, when the working parts have got worn out of truth slightly. When new, however, a large firm of turret-lathe makers in this district have tested their machines by the following method for a number of years with satisfactory results.

After the false nose for securing the spring collets has been screwed into position on the lathe spindle, as shown in Fig. 1 (the nose being shown at Fig. 3) a small internal grinding attachment is mounted on the shears, and the inside conical surface *D*, of the hardened nose which locates the spring collets, is accurately ground. This method insures the part which guides the collets, and also the work in turn, being absolutely true. A dummy collet is now turned (as shown at Fig. 2) the same size as the spring collets are for this particular lathe. On the front end is turned a long, straight pin *A* (solid with the back portion of course) between the centers of an accurate engine lathe. This collet or test bar is now gripped securely in exactly the same way as a spring collet would be. The part *A* is now tested for accuracy by revolving the lathe, and a turned-steel bar *B* is gripped in the turret holes, as shown in Fig. 1. This bar is the same size as *A*, and should be a good fit in the turret holes.

A steel ring gage *C* is slipped over *A*, and brought up to *B*, to see if it slides over freely while *A* is revolving. If it slides over freely, which an experienced man can tell by sense of touch, *B* is taken out and the capstan brought forward and *A* should then revolve freely in the turret holes. Should the lathe be to the inspector's satisfaction, it is passed as ready for despatching, if not, however, the holes in the capstan have to be rebored and bushed, which with care will put matters right.

Some mechanics may not consider this bushing very good practice, but the chief foreman over the capstan department,

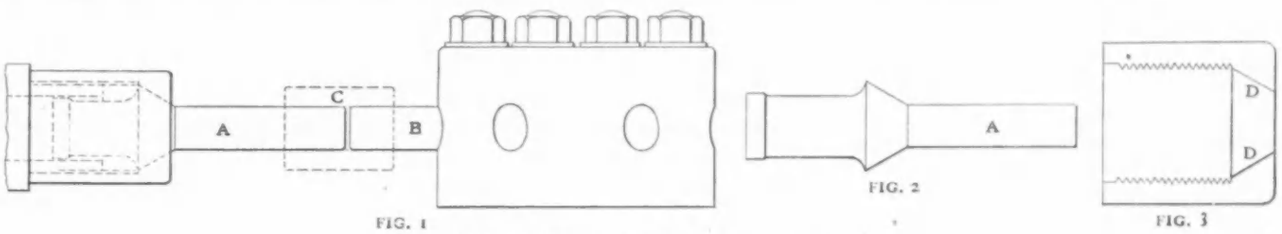



FIG. 1 FIG. 2 FIG. 3

TESTING TURRET LATHES FOR ALINEMENT

who has had many years' experience, much prefers a bushed hole in a capstan to one bored out of the solid, as should the holes get worn by continual slackening and tightening, all that is necessary to make the hole a good fit on the shanks, is to draw the bush out and drive another in. This is certainly easier and better than boring the hole larger, and putting sockets, etc., on the tool holders to make them fit the holes.

I don't remember ever having noticed any of the American turret lathes with bushed tool holes, and it would be interesting to know what their objections are to the method, as the method here described is that of one of the largest and best known turret-lathe makers in this country.

H. V. TEMPEST.

Manchester, England.

## Forging Chain Hoist and Crane Hooks

From time to time articles have appeared on the design and construction of chain hoist and crane hooks. Most of them, however, have been of a purely technical nature, couched in language that might as well have been Greek for all the benefit the blacksmith who has to forge the hooks has derived from them. There are few high-school graduates and, I think I am safe to say, no college men employed as blacksmiths, therefore, anything that is written with the intention of benefiting the blacksmith and assisting him to do his work must be denuded of technicalities and written in the simplest language, so that with his limited education he may have a chance of grasping the full meaning and derive the intended benefit.

The first information on the subject that would in any way be beneficial to the blacksmith was written by S. L. Reginald and appeared on page 269 of the AMERICAN MACHINIST. He had explained every operation that is gone through from the time the material is cut in suitable lengths until the hooks are complete as forgings, but has omitted to give some of the most essential information regarding the diameter and length of material to use for hooks of different capacities, or any rule whereby the workman may arrive at a definite conclusion on the amount of stock to use.

His table of dimensions is also a little out of the way and would be rather difficult to work to. Take a one-ton hook for example, and suppose it is to be forged from material of 1⅛ inches diameter, which is generally considered the correct size to use for a hook that will take a working load of 2000 pounds; bend it and taper the back, leaving it 1 inch at *C*. In accordance with his table the material is not in it to make it 1¾ inches at *B*. The extreme width when drawn down to a feather edge will not exceed 1 7/16 inches. The same mistake occurs on all sizes of hooks throughout his table of dimensions.

I have had over twenty years' experience as a blacksmith, having made hooks and seen them made by others for nearly all purposes for which hooks can be used, and will give what I consider the most

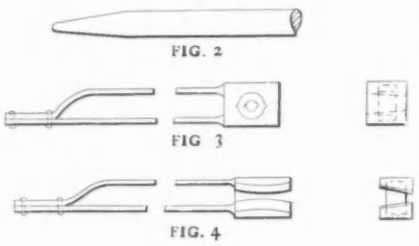


FIG. 2

FIG 3

FIG. 4

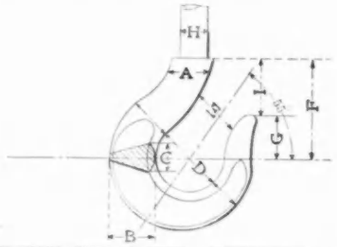
TAPERED BAR AND SWAGES

essential information on the subject, together with a description of the tools and appliances generally used where much of this class of work has to be done.

To determine the size and exact amount of material to use for hooks of different capacities, the simplest plan is to multiply the size of the chain for which the hook is intended by 2½; this will give the correct diameter of the material to use. When the diameter has been determined, multiply it by 7 to get the length. Take for example a chain of standard pattern made from 7/16-inch material, which is generally recognized as the right size for a working load of 2000 pounds, and work it out as follows:

$$\tfrac{7}{16} \text{ inch} \times 2\tfrac{1}{2} = 1\tfrac{3}{32} \text{ inches.}$$

There being no standard material of this size, stock of 1⅛ inches diameter has to be used, and answers the purpose equally well. 1⅛ inches × 7 = 7⅞ inches. This is the right amount of material to make a one-ton hook of proper proportions and in accordance with the table of dimensions given in Fig. 1. This rule holds good on hooks of all sizes from ⅛ of a ton up to the largest sizes. Hooks up to 3000 pounds capacity can be made from the end of a length of material which ought to be cut so that a certain number can be made without wasting a portion of each length. The first operation is to taper the end of the stock, as shown in Fig. 2, which is done at the steam hammer by means of spring swages of the style shown in Fig. 3. The impressions in the swages are made the same taper as the points of the hooks and are well backed off on the lips, or edges, to prevent forming a fire or flash on the work. When a flash is formed upon circular work while being




| Tons | Lbs. | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|---|
| ⅛ | 250 | 5/8" | 27/32" | 35/64" | 1 5/16" | 1" | 1 15/16" | 15/16" | 9/16" | 1" |
| ¼ | 500 | 11/16" | 15/16" | 5/8" | 1 3/8" | 1 1/16" | 2 1/16" | 1" | 5/8" | 1 1/16" |
| ½ | 1,000 | 3/4" | 1" | 21/32" | 1 1/2" | 1 1/8" | 2 3/16" | 1 1/16" | 11/16" | 1 1/8" |
| 1 | 2,000 | 1 3/32" | 1 7/16" | 15/16" | 1 3/4" | 1 5/16" | 2 11/32" | 1 7/32" | 13/16" | 1 5/16" |
| 1½ | 3,000 | 1 1/4" | 1 11/16" | 1 1/16" | 2" | 1 1/2" | 2 7/8" | 1 3/8" | 1 1/8" | 1 1/2" |
| 2 | 4,000 | 1 3/8" | 1 7/8" | 1 3/16" | 2 1/4" | 1 11/16" | 3 1/4" | 1 9/16" | 1 1/4" | 1 11/16" |
| 3 | 6,000 | 1 3/4" | 2 5/16" | 1 9/16" | 2 3/4" | 2" | 3 7/8" | 1 7/8" | 1 9/16" | 2" |
| 4 | 8,000 | 2" | 2 11/16" | 1 3/4" | 3 1/4" | 2 7/16" | 4 11/16" | 2 1/4" | 1 3/4" | 2 7/16" |
| 5 | 10,000 | 2 1/4" | 3" | 1 15/16" | 3 3/4" | 2 13/16" | 5 3/8" | 2 5/16" | 2" | 2 13/16" |
| 6 | 12,000 | 2 1/2" | 3 3/8" | 2 1/8" | 4 1/4" | 3 3/16" | 6 1/16" | 2 7/8" | 2 3/16" | 3 3/16" |
| 8 | 16,000 | 2 7/8" | 3 7/8" | 2 7/16" | 5 1/4" | 3 15/16" | 7 1/2" | 3 5/16" | 2 1/2" | 3 15/16" |
| 10 | 20,000 | 3 1/4" | 4 3/8" | 2 3/4" | 6 1/4" | 4 11/16" | 8 15/16" | 4 1/4" | 2 7/8" | 4 11/16" |

FIG. 1. TABLE OF PROPORTIONS OF HOOKS

swaged it will not be worked into the body of the piece when it is turned for the next blow of the hammer, but will be bent over and form what is known as a cold shut, which is a deep mark or loose portion on the surface.

The swages being made in two separate parts and held together by rivets at the end of the handle or spring, gives them the advantage of keeping in alinement without having to use a guide pin or any other device to keep the working parts

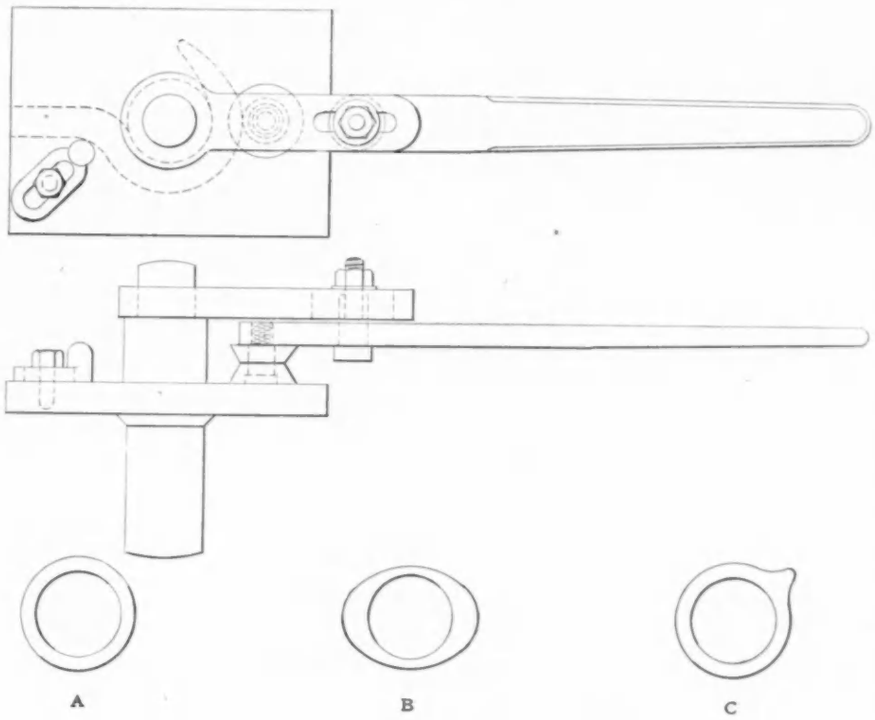



FIG. 5

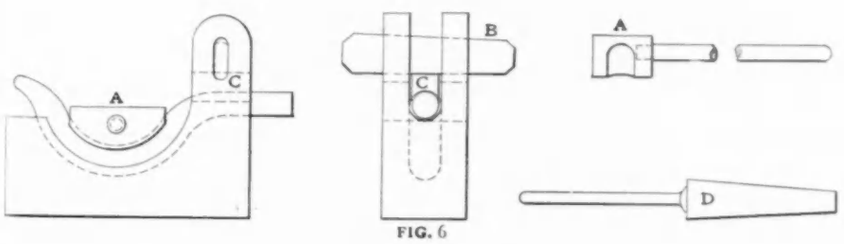



FIG. 6

BENDING TOOLS

matched. The offset on one side of the handle also insures their being placed on the die of the steam hammer right side toward the blacksmith. When the material for the hook has been tapered it is reheated and bent to about two-thirds of a circle by means of a former, shown in Fig. 5. The former is made on the same principle as that shown and described by Mr. Reginald, but has several improved features which make it a handy tool for bending work other than hooks. Being adjustable throughout, a number of sizes of material come within its capacity. The circular projection around which hooks are bent, the body and the shank to fit the square hole in the anvil are made from one solid piece of machinery steel. The circular stud at the lower left-hand corner around which the necks of hooks are bent has a slot in the base or foot which allows of its being set to any angle, or to suit any size of material, and is held in position by a cap screw.

Over the top of the former a lever is fitted in the other end of which there is a slot. A bolt with flat sides passes through this slot and connects the lever with a handle forming a joint which is adjustable. To the short end of the handle a roller is attached around which there is a V-shaped groove of about 120 degrees; the roller being counterbored to accommodate the head of the screw. When the roller is brought to bear on the work to be bent the handle should stand about 10 degrees to the left of a straight line with the lever. This prevents jamming, and also makes it possible to follow irregular curves. *A*, *B* and *C* are samples of loose bushings that can be used to increase the size of the former and to bend work other than circles. These bushings can be held in position either with a headless set screw, or a key. When the hooks have been bent to about two-thirds of a circle, as shown by dotted lines in Fig. 5, they are received from the former and are tapered on the back at the same heat. This is done by using a tapering tool made on the same principle as the spring swages, and shown in Fig. 4. The faces of this tool are made slightly convex both ways to prevent unsightly marks being left upon the hooks; being the same taper on both sides gives it an advantage over the single-tapering tool which is liable to work all the taper to one side. In this operation the hooks close in at the point until they are just about right, leaving very little finishing to be done by hand.

Hooks over 3000 pounds capacity are too heavy and stiff to be made on the end of a length of material, or bent in the same manner as smaller sizes, therefore the material is cut into lengths which will each make a single hook. The point is tapered in the same manner as smaller sizes. The pieces are then heated all over and the bend started in a fixture, as shown in Fig. 6, which is placed under the steam hammer. The stock that forms the shank of the hook is placed in the circular impression between the lugs of the former. A small steel block *C* is then placed on the top and held in position by the steel wedge *B*. A steel block *A*, the face of which is made on an arc with a groove running the whole length of the face, is placed on top of the work; steam is admitted to the cylinder of the hammer which presses the hook down to the shape of the former. The hook is then removed from the former and the bending operation completed either by being pressed to the desired shape by the steam hammer, or by light blows, if the hook is of large dimensions. The backs are tapered in the same way as smaller hooks, and the inside is trued to shape on a taper mandrel, shown at Fig. 6, which can be used for a number of different sizes.

The best material to use for chain hoist or crane hooks is norway or lowmoor wrought iron which will always give warning when overloaded by bending. Machinery steel, although stiffer, is more liable to snap and result in accidents. It is good practice for those using hooks and chains to have them annealed occasionally, as they get crystallized and brittle after a certain length of time. If this is attended to it will increase the life of a chain or hook and limit breakage.

Plainfield, N. J. JAMES CRAN.

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A well-founded enthusiasm is catching, and will reach your patrons, and make patrons, if you will only make it visible.

# AMERICAN MACHINIST

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## Progress in Fireproof Building Construction

The American people are frequently reminded of their enormous annual loss by fire, due to the prevailing construction of buildings of timber with a resulting high degree of inflammability. These warnings are constantly increasing in volume, and, loud as they are, they ought to be still louder, as these losses constitute an annual drain of the most serious magnitude upon not only our resources, but our accumulated wealth as well.

At the same time we very much doubt if there is any general appreciation of the great progress that has been made in fireproof construction during the past 25 years. The reinforced-concrete dwelling house built by W. E. Ward and described in a paper read before the American Society of Mechanical Engineers in 1883, to which we have made recent reference in these columns, was, of course, an example of thoroughly fireproof construction, and it was about this feature of it that much of the discussion related. That discussion is an instructive exhibition of the prevailing ideas of the time regarding what constituted fireproof construction, and it is so striking that we reproduce below a few words by W. Barnett Le Van, whose remarks occur near the beginning of the discussion. Said Mr. Le Van:

"Mr. President, I would like to state in connection with fireproof buildings that the Brown building just finished in Philadelphia from plans furnished by Cabot & Chandler, and Amos J. Boyden, is considered fireproof. All the floors and roofs are of heavy planks on wooden girders, the latter being reinforced by iron plates or beams only where partitions may in future be removed, or where, from other causes, there may be great weight to support, and in all cases iron so used has been inclosed in solid wooden beams, and both beams and ceilings thoroughly fireproofed by heavy mortar coats on strong wire cloth.

"All partitions are either brick or tile, and upper surface of the plank floors is covered with a thick fireproof mortar coat over which the finished floor is laid and no spaces left for fire or vermin to lurk in. Where spaces have been unavoidable (as between roof and ceiling in rear parts) they have been filled with mineral wool. The stairs are fireproofed by iron castings, plaster and asbestos paper, and only a light oak finish is left exposed.

"The insurance companies of Philadelphia considered the risk so small that they have insured this building for five years at the rate of 50 cents on $100, or at the rate of ½ per cent., the cheapest rate in the city."

This was written only 25 years ago, and it was given as an illustration of the most advanced fireproof construction at that recent date. From the construction thus described to the present steel and concrete buildings is certainly a far cry. Probably no buildings are being built today which are more fireproof than Mr. Ward's dwelling house, but that stood out as a bold example of pioneer construction, whereas today steel and concrete buildings are commonplace. Serious as is our fire loss, and we have no desire to minimize it, but rather the contrary, we are nevertheless compelled to find satisfaction in the evidence of progress made. Moreover, this progress was never so rapid as today, and with the increasing cost of timber we are sure to see a rapid acceleration of this rate. We are told that every cloud has its silver lining, and this progress is the silver lining of the cloud that hangs over our timber supply.

Perhaps the best gage of this progress is the reduction in insurance rates since the above quotation was written. Accurate comparison under identical conditions other than the character of the buildings is extremely difficult, but we are informed that the best office buildings of this city are now insured at rates below 10 cents per $100, and that the best factory buildings, when fitted with sprinklers, are taken at as low a rate. Of course, the Brown building did not have the advantage of sprinklers, which were not then in use, but they should be included when discussing the advances that have been made in construction toward a reduced fire risk.

Where shall we draw the line? To the extent that patent protection obtains it is easy to draw the line at the expiration of the patent, but this fails in the cases of numberless unpatentable features, and, with the practical abrogation of patent protection in foreign countries through the compulsory working clause of patents issued by those countries, it fails again. In any case, the appeal to the patent criterion transfers the question from the field of morals to that of law, and that at best is unsatisfactory.

The question is one which we will not attempt to answer, because we are not able to answer it. We have as much sympathy as anyone can have with American machine-tool manufacturers, whose work is now being simply stolen by the wholesale, but we believe the line indicated cannot be drawn. It is easy to express an opinion in an individual case, and to cover the general question by saying that when a device or feature has become common property it may be used by all, but this only begs the question. In every case it will be found that the first use of the device by someone other than its inventor was a piece of rank copying, and without such first copying the device would not have become common property. The subject is, we believe, one of the most puzzling connected with the machine-building industry.

# New Tools and Machine Shop Appliances

## Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

## THE LATEST INFORMATION

### Cam Milling Machine

This machine is designed for milling the cams on motor-car cam shafts and may be used either for shafts with cams solid, or for milling loose cams, though in the latter case the cams should be fixed on the shaft prior to milling in order to insure their being in the proper relation one to another. The machine is well illustrated by Fig. 1, and a typical cam shaft which it is adapted to handle is shown in Fig. 2.

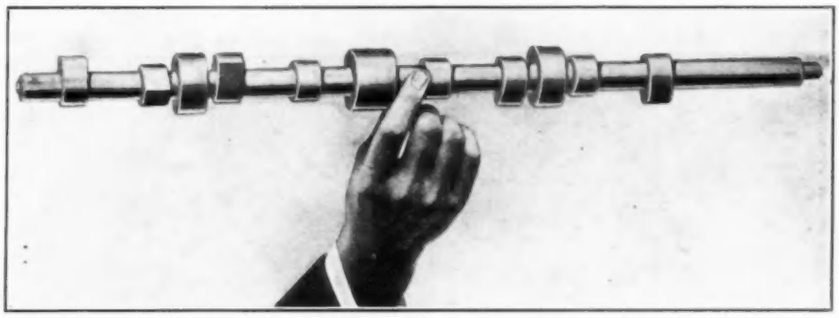


FIG. 2. CAM SHAFT

The spindles in both the work and cutter heads are of steel and run in adjustable bronze boxes. The main or work spindle carries the formers, as shown, and as many as six formers may be carried at one time, thus making frequent changes unnecessary. The cutter head is held up to the formers by means of a weight, a hand lever being provided for moving the cutter from the work when desired. When changing from one cam to another all that is necessary is to move the guide roller along from one former to the other.

The cam shaft is prepared in a lathe as usual, collars being turned to the finished width of the cams, and of a diameter just sufficient to allow of a slight cut being taken off the highest part of the cams. The work is then ready for milling. When being milled the shaft is held in a sleeve that passes through the main headstock spindle, and which may be moved longitudinally. For additional security a three-jaw, self-centering chuck is provided on the end of the spindle in which the shaft is gripped close to the cam being operated upon. This chuck has to be released to enable the shaft to be moved longitudinally, but the shaft is held at all times by the internal tube, so that the indexing mechanism which is connected thereto may give the correct relative positions of the cams. This indexing arrangement is of simple construction and insures the cams being milled in correct relation to each other.

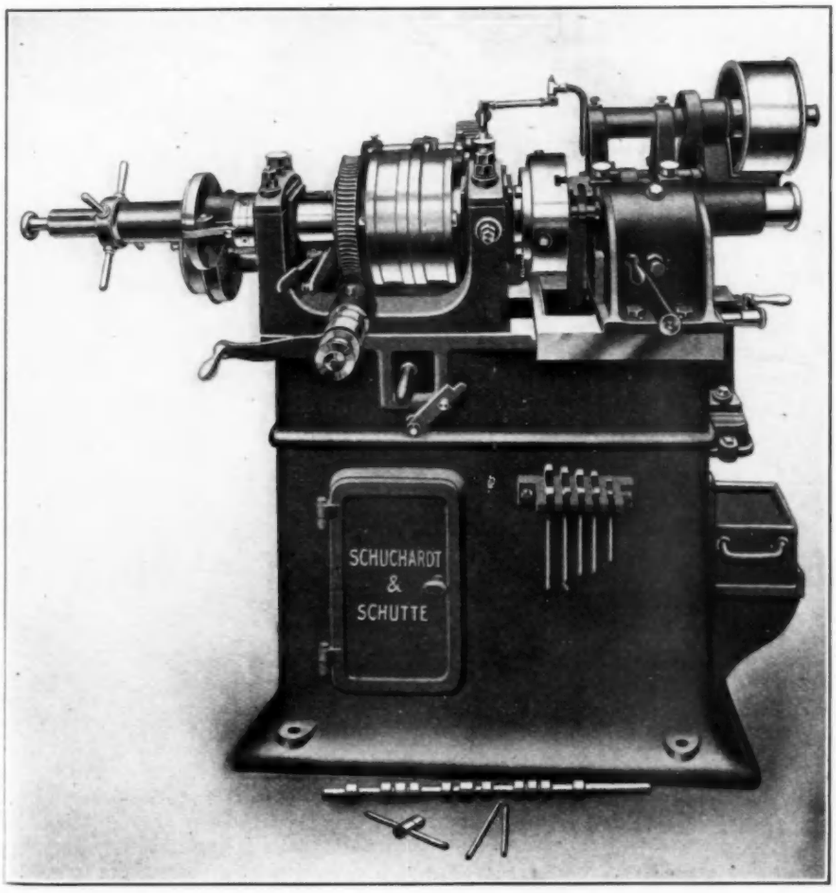



FIG. 1. CAM MILLING MACHINE

The support for the cam shaft consists of a long guiding tube, which is part of a bracket supported directly from the saddle; and bushings are used which fit this tube and which receive the cam shaft so that as each cam is milled it is properly supported at one side by the chuck and on the other by the steady bushing.

The work spindle is usually driven one turn in 8 to 10 minutes, and the feed for the cutter is from 0.005 to 0.008 inch per revolution. Where the cams are to be ground they require milling only once around, but if a finer finish is required two cuts are taken around the work.

Provision is made in this cam miller whereby the formers may be easily laid off on the machine. A properly finished cam is put in the machine in the usual way, a roller is put on in place of the cutter, and a scriber point is located where the former roller should be; the machine is then pulled round by hand, thus marking the correct outline on the former plate, which may then be taken out and given the correct shape.

The machine will mill cams up to 2⅜ inches diameter and covering a maximum length on the shaft of 2 feet 11 inches. The diameter of the formers or master cams is approximately 12 inches. The machine is built by Schuchardt & Schütte, 136 Liberty street, New York City.

## The F. & S. Annular Ball Bearing

The two accompanying half-tone illustrations show a new ball bearing made by Fichtel & Sachs, Schweinfurt, Germany, and imported and handled in this country by J. S. Bretz Company, Times building, New York City. It is characterized as a silent annular ball bearing. The method of introducing the balls into the races is the same as is used by this firm in other bearings, and consists in angular entering grooves in the sides of the races. After the bearing is half filled with balls the remaining balls are introduced by springing them under pressure through these angular entering grooves.

The distinctive feature of this new bearing is the separator. This is a die casting made from a special alloy, and without any machine work. It is split along the central plane of the balls and the two halves are held together by brass locking wires of a dovetailed section. These wires are inserted in dovetailed-shaped grooves and have their ends clinched over into notches in the sides of the separator.

The bearing is intended for general machinery purposes and will sustain thrust loads of 1/10 to ¼ of their rated radial-load capacity.

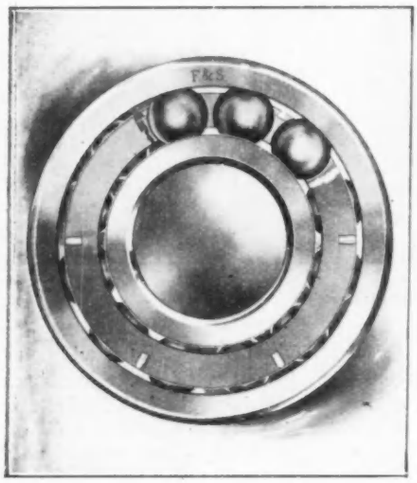



FIG. 1. AN F. & S. BALL BEARING

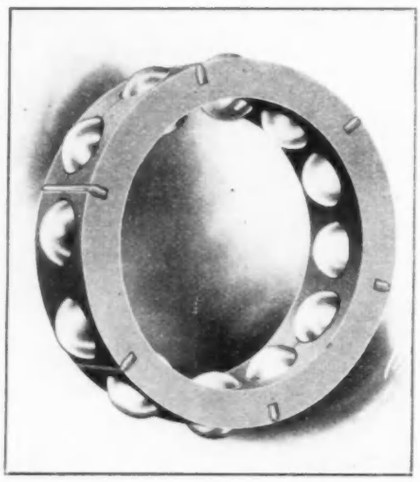


FIG. 2. BALLS AND SEPARATOR OF AN F. & S. BALL BEARING

## A Multiple Spindle Boiler Shell Drill

Fig. 1 shows a general view of a new multiple-spindle boiler shell drill. In the center is a vertical stub which carries a face plate or table 10 feet 10 inches in diameter. The boiler shell is placed on end on this face plate, which is provided with radial T-slots for securing the work. Where the work is larger in diameter than the table, I-beams, as shown in Fig. 1, or other suitable extensions can be bolted to the table for the boiler to rest upon.

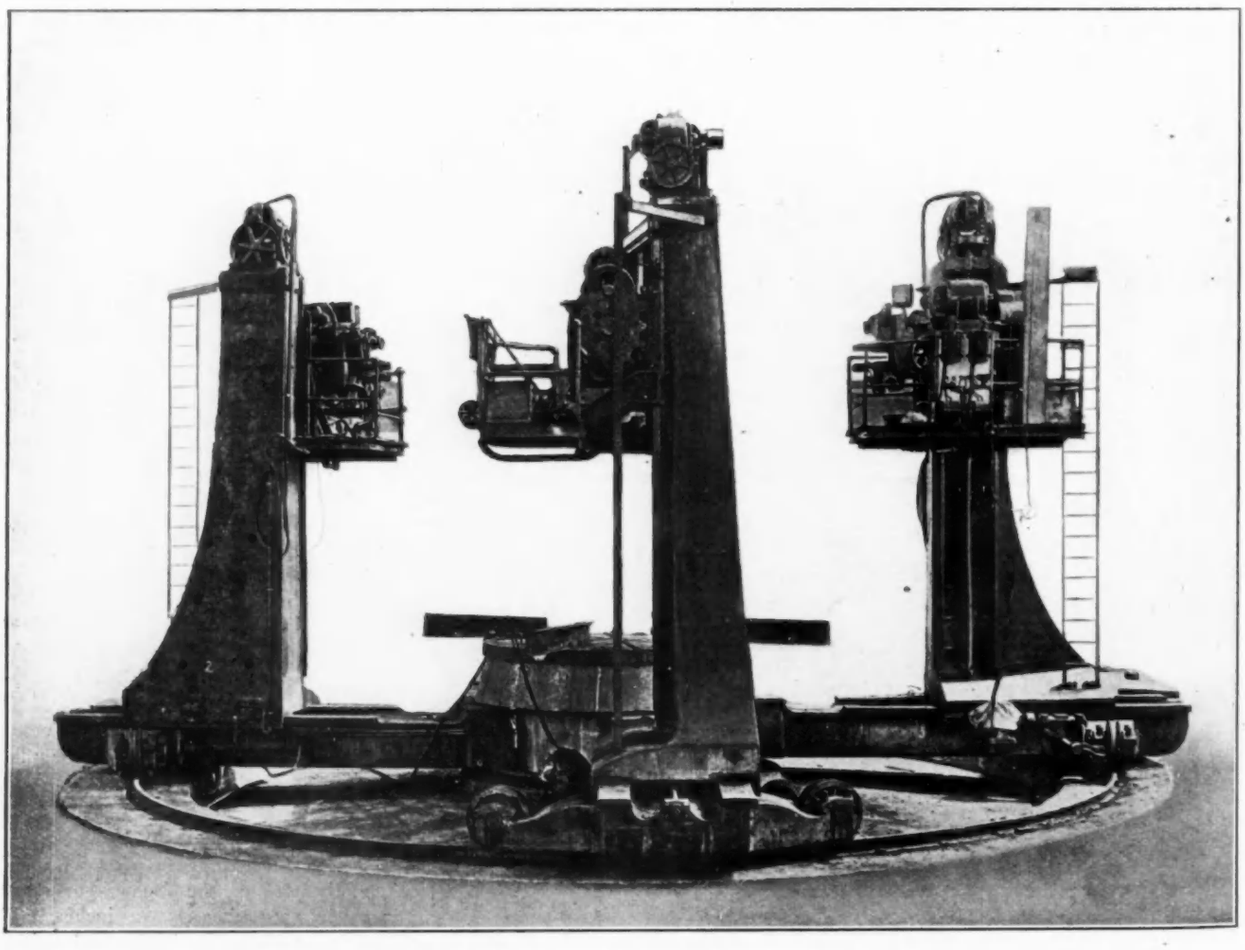


FIG. 1. A MULTIPLE-SPINDLE BOILER SHELL DRILL

Around the stub are two concentric circular tracks, one of them under the rim of the face plate or table and the other some 45 feet in diameter. Upon these tracks are radial carriages (see Fig. 2), which are provided with flanged wheels which ride on the inner and outer tracks. These carriages vary in number from one to four according to specification. They are independently operated each by a 5-horsepower motor. Mounted on the carriages are vertical columns which have seven feet of radial adjustment on the radial carriages. The adjustment is by means of a screw which can be operated either by hand or power.

On top of each vertical column there is a 5 horsepower motor for operating the vertical adjustment of the drilling head, mounted on the column, through its 12 feet of traverse. The drilling head is counterbalanced by a weight in the column.

The drilling heads are provided with four spindles each, and each spindle is capable of independent adjustment by hand so that one, two, three or four holes may be drilled at one setting within a circle 16 inches diameter. The minimum distance between hole centers is 5 inches, but by staggering the drilling this is reduced to 3⅜-inch centers. The drilling heads are each provided with a 7½-horsepower variable-speed motor which drives the feeds and the four spindles. In addition to the variations obtainable through the motor the spindles are back geared and the feed gears are so arranged that four gradations of feed are obtainable.

The drilling heads have 12 inches of horizontal movement and will drill four 1½-inch holes simultaneously in boiler shells from 9 to 21 feet diameter. The uppermost hole may be drilled 13 feet 6 inches above the table and by inverting the work a shell over 24 feet long can be handled.

All movements of the machine are controlled by the operator from his platform at the side of the drilling head. This machine is built by the Bethlehem Steel Company, South Bethlehem, Penn.

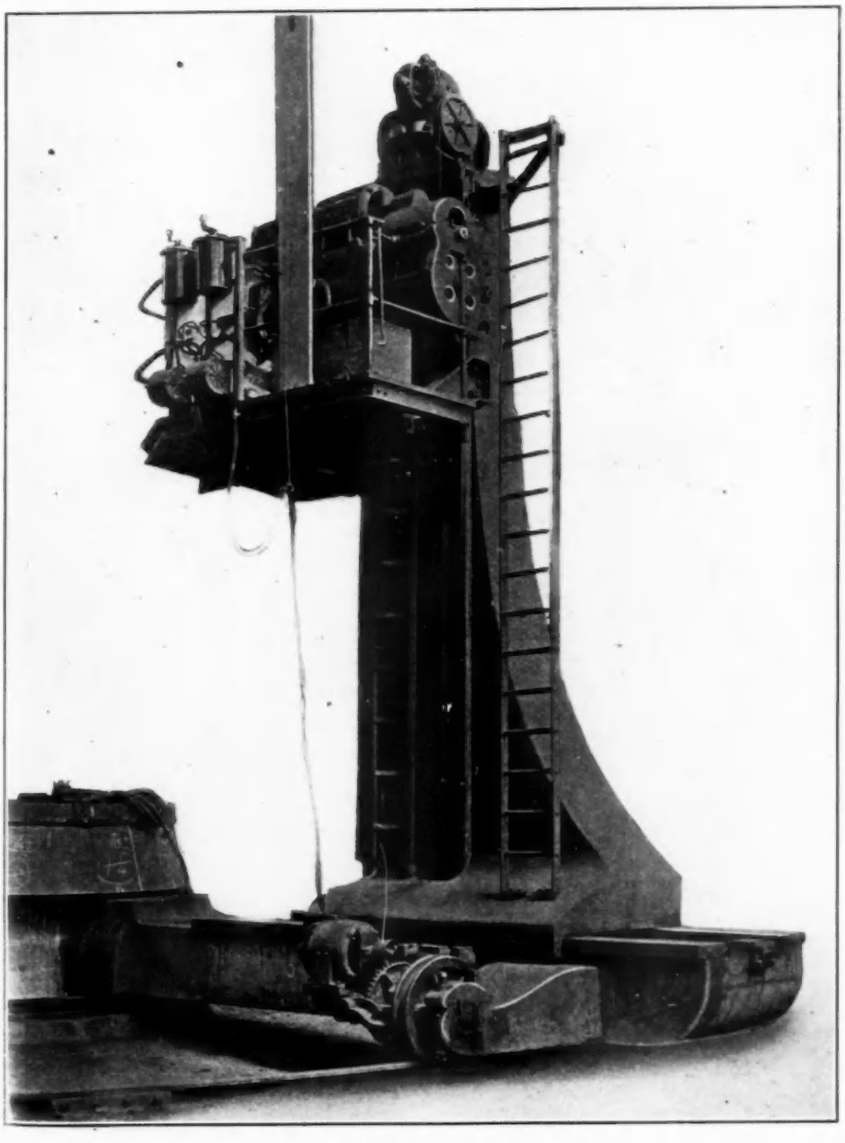
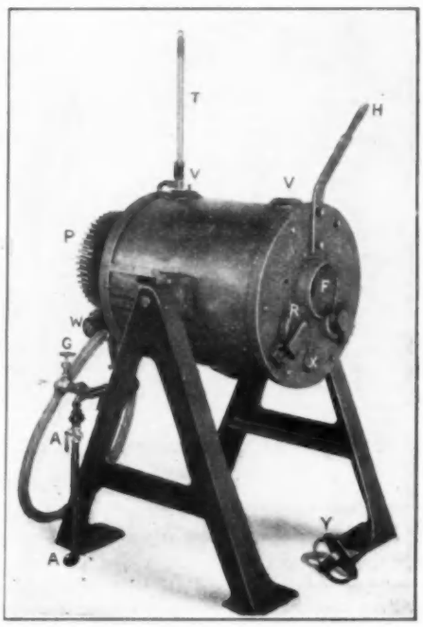


FIG. 2. INDIVIDUAL RADIAL COLUMN AND CARRIAGE

## A New Heating Machine

This machine has been developed for tempering and coloring parts made from steel, and is practically an improved tumbling barrel heated uniformly, and provided with gas and air valves and a thermometer so that the temperature can be controlled accurately. Referring to the reference letters on the accompanying




A NEW HEATING MACHINE

half-tone, the gas valve is represented by the letter *G*, the air valve by *A* and the thermometer by *T*. The drum is inclosed by the heated chamber and revolves upon the rollers *R*. These rollers are in pairs; one pair on each end of the machine. The end of the drum is reduced to a neck *F* through which work is fed and discharged. The cover for this opening is indicated by the letter *Y*, and is used to close the entrance into the drum during the operation of heating. The drum is slowly rotated by power through the gear *P* and the worm *W*. The burners are lighted by opening in the slide and after lighting they can be seen for proper adjustment by making use of the peek hole *X*. A vent for the escape of the gases of combustion is indicated by the letter *V*, and a handle *H* is provided to tilt the furnace in discharging the work.

The quantity of work that can be put in the furnace at a charge depends upon the weight, shape and dimensions of the individual pieces. Work which is light and does not pack closely can be filled to a level with the bottom of the entrance at *F*. Work that is apt to bunch or clog, or for some other reason does not tumble readily, must be treated in small quantities. The diameter of the drum is 14 inches, its length is 12 inches, and the drum opening is 6 inches in diameter.

This machine is known as Heating Machine No. 51, and is built by the American Gas Furnace Company, 24 John street, New York City.

## New Departure Two-in-One Annular Ball Bearing

The New Departure Manufacturing Company, of Bristol, Conn., has developed

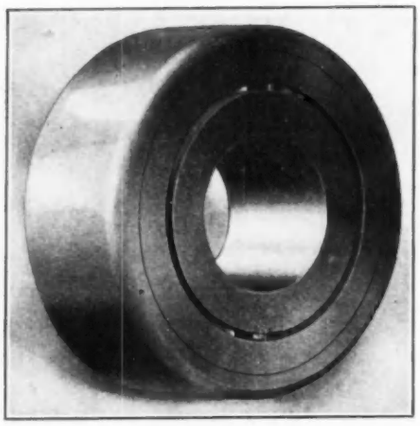


FIG. 1. NEW DEPARTURE TWO-IN-ONE BALL BEARING

and placed on the market a new type of ball bearing known as a two-in-one annular ball bearing. The reason for the expression "two-in-one" is that the bearing is adapted to sustain radial loads, thrust loads, or any combination of thrust and radial loads. This result is accomplished by arranging the ball races so that the line of pressure is either at an angle of 45 degrees, or 60 degrees with the

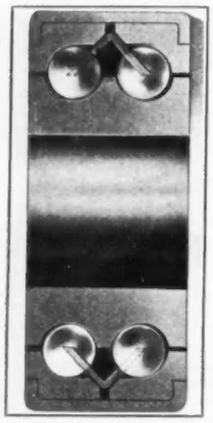


FIG. 2. SECTION OF NEW DEPARTURE BALL BEARING

horizontal, when the axis of rotation of the bearing is horizontal.* The bearing has been designed for general use and has already been adapted to automobiles, special machinery and for power-transmission purposes. In many places one of these bearings is used in lieu of a combination of a thrust and radial bearing or two thrusts and one radial of ordinary design.

Referring to the accompanying half-tone illustrations: Fig. 1 shows a complete and assembled bearing, Fig. 2 a section of such a bearing, and Fig. 3 a similar bearing disassembled. There are but five parts exclusive of the balls. The cone is provided with two semi-circular races to receive two rows of balls; this cone is shown in the lower part of Fig. 3. Directly above it is seen a steel separator that establishes and preserves the relative position of all of the balls in the bearing. It will be noticed that the ball-retaining notches in this separator are staggered. Thus the balls in the two rows are staggered with reference to one another. On either side of the separator in Fig. 3 are the cups, and above the separator is the shell or casing.

The relative positions of all of these parts when assembled can be seen in Fig. 2. Considering this illustration there are three points which should be carefully noted. First, the line of pressure of cone, cups and balls makes an angle of 45 degrees with the horizontal. This fact is true of both rows and is the feature that adapts the bearing for radial, thrust, or angular loads. Second, the ball separator touches the ball at one end of the axis of ball rotation; the ball recesses in this separator are made to a slightly larger radius than the ball radius; thus the contact between the separator and ball is

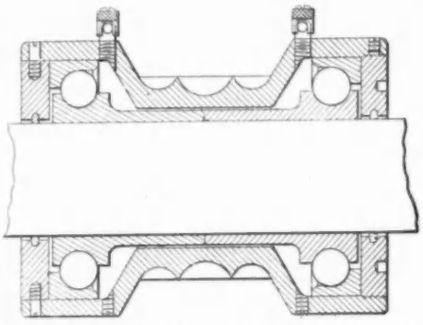


FIG. 4. A NEW DEPARTURE BEARING ADAPTED TO POWER TRANSMISSION PURPOSES

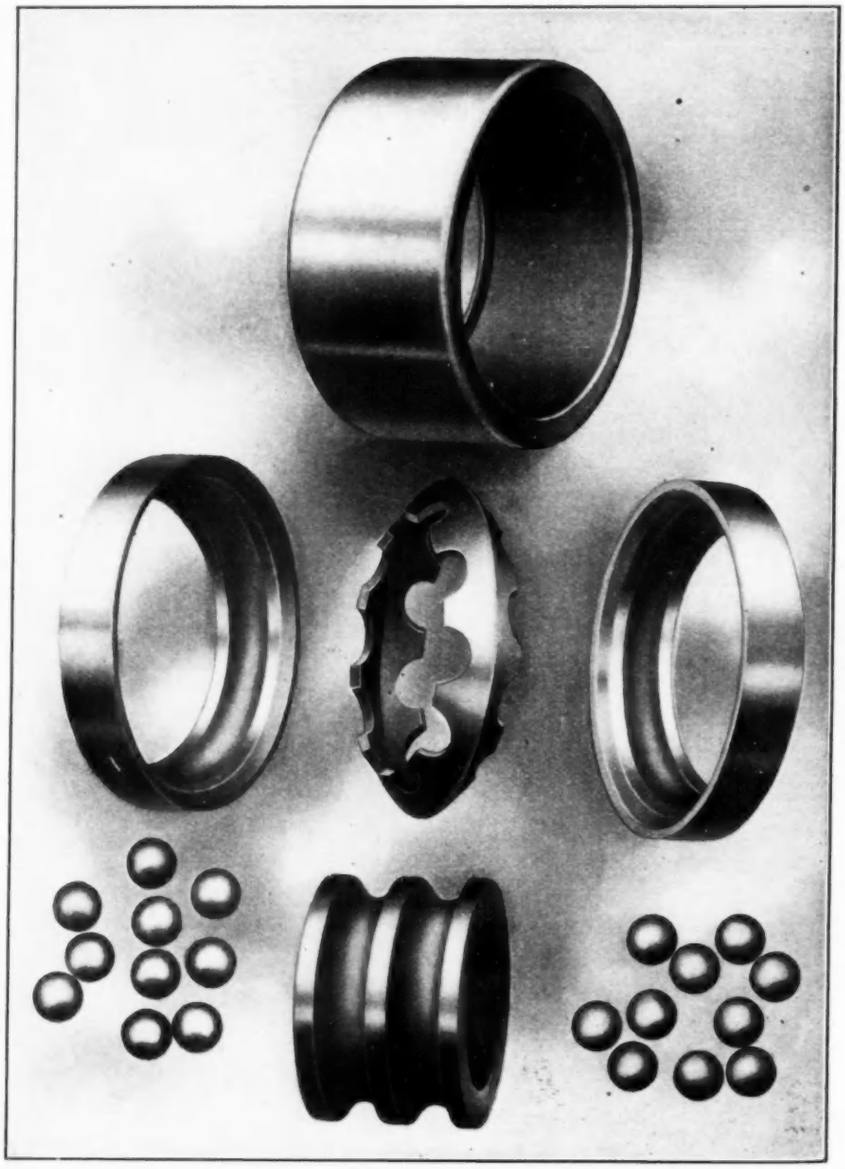
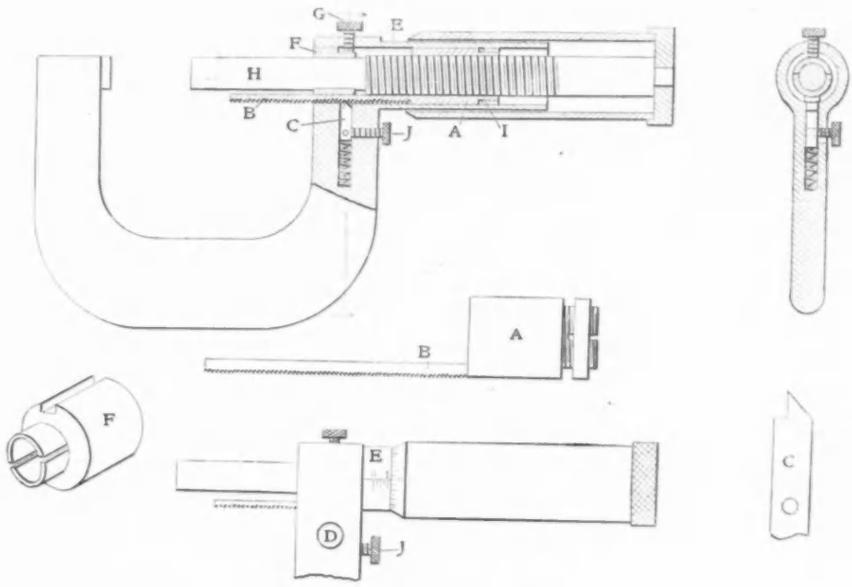


FIG. 3. NEW DEPARTURE BALL BEARING DISASSEMBLED

practically a point contact at one end of the axis of ball rotation. Again, the weight of this separator is carried on the balls at the top of the bearing and thus on balls that are normally out of action. For this reason the friction introduced into the bearing by the addition of the separator is extremely slight and is a negligible quantity. As the separator prevents adjacent balls in the bearing from coming in contact, cross-friction between the balls is entirely eliminated.

## Quick Adjusting Micrometer

The drawing shows a micrometer graduated in the usual fashion, but with a spindle arranged to be slid longitudinally to any point required, within the range of the instrument. As will be seen, the nut *A* for the spindle is provided with a rack *B* whose teeth are engaged by a spring plunger *C*, the latter having a small knob at *D* by means of which it may be drawn out of contact with the rack teeth. The latter are spaced to correspond exactly with the graduations on the sleeve *E*. The rack slides in a groove in bushing *F* which is fixed in the front of the micrometer frame and split at the rear end so that it may be adjusted by screw *G* to put the required degree of pressure on spindle end *H*. The adjustment of the nut *A* through which the threaded portion of spindle *H* passes, is secured by a thin nut *I* which fits on the taper-threaded and split end of *A*. In operation, the plunger *G* is drawn down by knob *D* and the spindle *H* is then pushed forward until it nearly contacts with the work to be measured. The plunger *C* then engages the rack *B* and holds the nut *A* stationary while the spindle is rotated in the usual way for the final adjustment of the micrometer to the work. The teeth on the rack are so located that when the zero line of the thimble coincides with the longitudinal line on the sleeve *E* the plunger will seat exactly between the rack teeth and hold the spindle nut against further longitudinal movement while the spindle is being operated by rotating in the usual way. The screw at *J* is an extra safeguard against accidental movement of the plunger *C*. The patentee of this micrometer is H. O. Costello, 87 Oakland avenue, Providence, R. I.




QUICK ADJUSTING MICROMETER

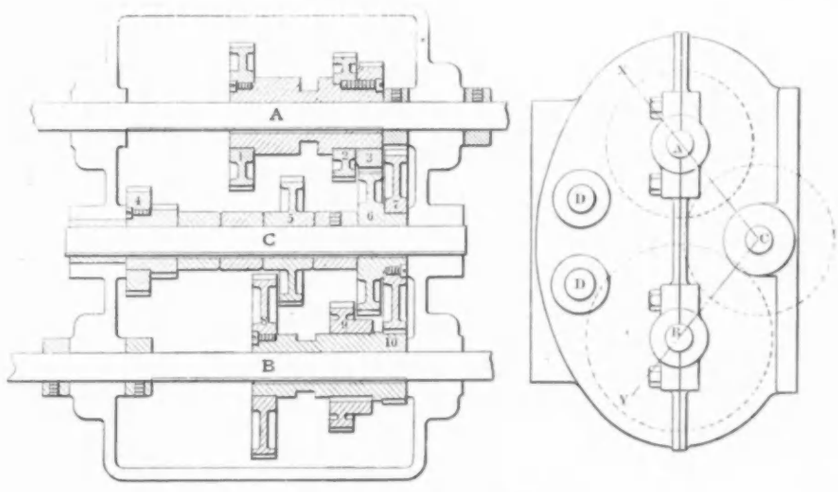
## Beaman & Smith Feed Box

The Beaman & Smith Company, Providence, R. I., is using the feed box shown, on several of its machines as it can be adapted to various conditions with little difficulty. Power can be applied to either end of the upper shaft *A* and taken off at either end of *B* so that it works easily into different designs.

The whole mechanism consists of 10 gears mounted on three shafts, the center gears being fixed to the intermediate shafts, while the gears on the other shaft can be moved at will into any of three positions.

In the position shown, gear 3 is driving gear 6, while gear 7 is driving 10 on the lower shaft. Moving the upper gears to the extreme left so that 1 would mesh with 4, gear 7 would still be driving 10 and the greatest ratio would be in use. This gives 9 changes with 10 gears.

The end view shows the location of the shafts *A*, *B* and *C*, which are not in line,




BEAMAN & SMITH FEED BOX

The third noteworthy feature is the shell. This is made of a tough quality of steel. When assembled this shell is drawn tightly over the cups and permanently fixes the relationship of cone, balls and cups.

These bearings are regularly designed for shaft diameters from about ⅜ inch up to about 4⅜ inches, and for three classes of service; referred to as light, medium and heavy. A numbering system has been adopted closely paralleling that which is in use by ball-bearing manufacturers the world over. Up to and including a shaft diameter of about 1¾ inches, the ball separator is used; beyond that point the bearings are designed for a separate ball contact, and for a 30-degree instead of a 45-degree line of pressure. The line engraving, Fig. 4, shows in section a bearing that has been applied to power-transmission purposes. The particular design of housing is to adapt it to a standard shafting hanger; here the line of pressure makes an angle of 30 degrees with the horizontal, and separate ball contact is used.

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For machining aluminum alloy castings a mixture of half kerosene and half lard oil will give good results. Fairly good results have also been obtained with sour milk.

the section being on lines *X C* and *C Y*. Rods *D D* are for shifting the gears on either side, *A* or *B*.

## Southern Supply and Machinery Dealers Association

A meeting of the officers and executive committee of the above association was held in Louisville on September 21 and 22, and aside from the regular procedure of business resolutions were passed reindorsing the "resale plan" as adopted by many of the manufacturers, and the maintenance of prices was urged upon all members.

Topics of considerable interest in connection with advances in railroad rates and the parcels-post system were discussed and the subject of marketing of products only through reliable dealers came in for a share of attention. At the conclusion of the meeting it seemed to be the prevailing opinion of the members present who were in a position to judge, that trade conditions were improved, and that the prospects for greatly improved business in the near future were bright.

## Personal*

William Lodge, president of the Lodge & Shipley Machine Tool Company, recently returned from a trip abroad.

J. D. Edmonds, for several years employed with the Western Electric Company, Chicago, has resigned his position to accept one as superintendent of works of the Stirling Electric Company, La Fayette, Ind.

George S. Cairnes has resigned his position with Houghton & Richards, Boston, Mass., and is now connected with the Carpenter Steel Company, of Reading, Penn., making his headquarters at 196 Adelaide street, Hartford, Connecticut.

Anson W. Richards, who for two years has represented Manning, Maxwell & Moore in Japan, Korea, Manchuria, China and the Philippine islands has just returned to this country. He expects to return about the first of next year making his headquarters in Tokio.

N. E. Hildreth, treasurer of the Hildreth Manufacturing Company, Lansing, Mich., and a contributor to our columns, has disposed of his interests in the company and expects to retire from active management in the concern. He contemplates an extended rest before deciding on his future plans.

Robert Langlotz, a well-known figure in engineering circles, has recently associated himself with Geo. H. Ward & Company, engineers and machinists, Brooklyn, N. Y., and will actively engage as a partner in the firm. Mr. Langlotz has acquired the interests formerly held by R. G. Davis, who has retired from business owing to ill health.

Francis H. Easby has recently joined the engineering staff of James B. Ladd, of Philadelphia, doing a consulting business. Previous to his present engagement Mr. Easby was connected with the Detrick & Harvey Machine Company for a long period, previous to which time he was in the employ of the Betts Machine Company and Pratt & Whitney.

*Items for this column are solicited.

## Business Items

G. A. Crayen & Co., of 16 Beaver street, this city, have established a metallurgical and engineering department which is in charge of M. R. Machel. Among other specialties they will handle metallic titanium as distinguished from ferro titanium.

## Trade Catalogs

Northern Electrical Manufacturing Company, Madison, Wis. Bulletin No. 59, illustrating and describing type S motors.

Whiting Foundry Equipment Company, Harvey, Ill. Catalog No. 54 describing tumblers. Illustrated, 16 pages, 6x9 inches.

Wallace Barnes Company, Bristol, Conn. Catalog of springs and circulars showing spring washers and machine screw products. Illustrated.

Nernst Lamp Company, Pittsburg, Penn. Bulletin B, describing Westinghouse Nernst multiple glower lamps. Illustrated, 40 pages, 4½x6 inches.

Ingersoll-Rand Company, 11 Broadway, New York. Catalog No. EE-36 describing small power-driven air compressors. Illustrated, 50 pages, 6x9 inches, paper.

Gem Manufacturing Company, Pittsburg, Penn. Catalog of oilers and torches, flexible shafting, loose pulley lubricators, etc. Illustrated, 42 pages, 6x9 inches, paper.

The Consolidated Supply Company, 321 Dearborn street, Chicago, Ill. Loose leaf catalog of general railway and mill supplies, electric railway and mining supplies. Illustrated, 6½x9½ inches.

Seamless Tube Company of America, Pittsburg, Penn. Catalog of seamless cold-drawn steel mechanical tubing. Illustrated, 32 pages, 4½x6½ inches. Catalog of seamless boiler tubes. Illustrated, 16 pages, 4½x6½ inches.

General Electric Company, Schenectady, N. Y. Bulletin No. 4616, illustrating and describing high-voltage type H transformers. Bulletin No. 4618, on belt-driven alternators, form PB. Bulletin No. 4619 entitled "Steady vs. Unsteady Voltage." Bulletin No. 4622, on polyphase maximum Watt demand indicator, type W.

## Business Opportunities

The Conneaut (Ohio) Can Company will build a new factory.

John N. Hart, Portsmouth, Va., will erect a new planing mill.

Wright Saulsbury, Catlettsburg, Ky., will rebuild sawmill recently burned.

Fire destroyed the plant of the Lima (Ohio) Paper Stock Company. Loss $10,000.

The Muller Gloria Silk Mills, South Norwalk Conn., will put up a one-story addition.

The Marshall (Texas) Car Wheel and Foundry Company is erecting an addition to plant.

It is reported that the Lexington (N. C.) Knitting Mills, recently burned, will be rebuilt.

Blake & Johnson, Waterbury, Conn., builders of wire forming machinery, will erect a new plant.

Fire in the roundhouse of the Canadian Pacific Railway at Montreal, Can., caused a damage of $20,000.

Hollis & Duncan, Chicago, Ill., manufacturers of paper bags, will erect a new factory to cost $100,000.

The Republic Stove and Manufacturing Company, Cleveland, Ohio, will erect a two-story addtiion.

The Western Electric Company, Chicago, Ill., has purchased site on which will be erected an addition to plant.

The Pacific Coast Condensed Milk Company, Kent, Wash., is preparing to build a plant for manufacturing cans.

The Russell Manufacturing Company, Middletown, Conn., makers of cotton goods, is erecting an additional factory.

A new finishing mill will be erected at the plant of the Lebanon Valley Iron Company at East Lebanon, Penn.

The plant of the Portland (Ore.) Mill and Fixture Company was destroyed by fire, causing a loss of about $25,000.

The Hoskins Manufacturing Company, of Chicago, Ill., making electrical devices, is planning to move to Detroit.

The Soo Line will build roundhouse and machine shops at Superior. The general offices are at Minneapolis, Minn.

It is reported the Oil Well Supply Company, of Pittsburg, will establish foundry and machine shop at St. Albans, W. Va.

Explosion at the plant of the Pittsburg Plate Glass Company at Tarentum, a suburb of Pittsburg, resulted in a $500,000 fire.

The Budd & Ranney Manufacturing Company, Columbus, Ohio, machinery and engine builders, will erect a new plant.

The Virginia Air Line will erect roundhouse car sheds, etc., at Gordonsville, Va., where headquarters of the line will be.

J. J. Tyler and J. I. Davis, Hepzibah, Ga., will form a company for the purpose of establishing a hosiery mill at Augusta.

It is reported that the Rockmart Stove and Foundry Company, of Rockmart, Ga., is negotiating for a site in Fort Worth, Tex.

The Basset & Eichlin Company, Janesville, Wis., will add an addition to its harness factory for the manufacture of horse collars.

A four-story addition will be built to the factory of Sachs & Trachtenberg, Philadelphia, Penn., manufacturers of store fixtures.

The Hart & Cooley Manufacturing Company, New Britain, Conn., making metal lockers, is planning to build a three-story addition.

The Watkins Machine and Foundry Company, Hattiesburg, Miss., will enlarge and improve repair shop and mill supply department.

Fire destroyed the sash, door and blind factory of the Wm. Mayer Company, Cincinnati, Ohio, causing a loss of about $60,000.

W. E. Muldrow Lumber Company, Pine Prairie, La., has been incorporated and will erect sawmill. W. E. Muldrow, president.

The Canada Metal Manufacturing Company, Toronto, Ont., will erect a plant for the manufacture of solder, babbitt and lead pipe.

Wright Bros., Marinette, Wis., whose plant was destroyed by fire, will rebuild. The company manufactured posts, poles, shingles, etc.

The Illinois Steel Company, of Chicago, Ill., has purchased property near Zanesville, Ind., on which it proposes to erect a $1,000,000 mill.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., October 22 for locomotive crane, flue welder, arbor presses, chucks, carborundum wheels, car springs, boiler tubes, rivets, bolts, nuts,

washers, screws, chain, twist drills, grindstones, saw blades, wrenches, screws, drivers, valves, cocks, track gages, electrical material, wire, packing, oil pumps, reamers, etc., as per Circular No. 471.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m. November 2 for pneumatic hoists, chain blocks, pipe-threading machine, geared shaper, motor-driven grinder, electric drills, band saws, planer jacks, cutting and milling tools, wire rope, wire, hose, vises, hammers, hinges, sash bolts, hooks and eyes, hasps and staples, cotton hooks, graphite, cylinder lubricant, as per Circular No. 473.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: October 19—Bolts and nuts (schedule 427), steel wire (schedule 426), pipe fittings (schedule 432), valves (schedule 437). October 27—Electric blowers (schedule 436), steam gauges (schedule 451), lubricators (schedule 445), exhaust fans (schedule 449), electrical supplies (schedule 444), bolts and nuts (schedule 416), metal lockers (schedule 452), lever punch, tool-grinding, saw gumming and sharpening machine, punching and shearing machine, cut-off sawing machine, bevel band saw, saw bench tilting table, drilling and tapping machine, planer knife grinder, resawing machine, automatic saw sharpener, automatic saw setting machine, circular saw grinding machine (schedule 436), machinery steel (schedule 451), tool steel (schedule 460). November 3—Tool and cutter grinder (schedule 463), bolts and nuts, nails (schedule 441).

# Want Advertisements

*Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.*

## Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Automatic machinery designed. Fred L. Fay, Wilmington, Delaware.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Orders for brass goods. Castings and finished product. Box 486, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Mechanical drawings correctly and quickly made. H. C. Karson, 39 Cortlandt St., New York. Room 123.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Wanted—A large pumping station for pumping natural gas. Inquire Pittsburgh Plate Glass Company, Room 1624, Frick Building, Pittsburgh, Pennsylvania.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Streets, New York City.

No Clinkers—If you use producers, I can stop them from clinkering and accomplish a material saving in fuel or permit the use of low grade fuels. Write for particulars. W. W. Hein, Fuel Expert, 65 Pine Street, New York City.

Wanted—Patented article that can be used in machine shop boiler room or engine room. Must have merit. We possess finest facilities for marketing, having a large force of traveling men in this country, and agents in nearly every large city in Europe, who call upon steam users and machine shops. Liberal contract. Highest of references. Address Diamond Power Specialty Co., 236 Fort St., W., Detroit, Mich.

Firm to manufacture small, newly patented article of german silver, requiring hard soldering, nickel plating and buffing. Will furnish parts ready for assembling. Box 541, AM. MA.

## Situations Wanted

*Classification indicates present address of advertiser, nothing else.*

CONNECTICUT

Wanted—Position as chief engineer or in charge of repairs and maintenance in manufacturing plant. Have had experience in manufacturing plant, street railway and lighting stations and machine shop. Box 549, AM. MA.

ILLINOIS

Designer with an extensive experience on machine tools and small tools and fixtures. Box 553, AMERICAN MACHINIST.

MARYLAND

Mechanical expert, practical, inventive and systematic, desires responsible position. Box 551, AMERICAN MACHINIST.

MASSACHUSETTS

Who wants a boss toolmaker; 20 years' experience. Box 530, AMERICAN MACHINIST.

Mechanical engineer, 32, desires position. Graduate Massachusetts Inst. Tech.; married; practical, energetic, inventive; 10 years' developing machinery, handling men; six years present position; go anywhere. H. R. Gilson, 255 Atlantic Ave., Boston.

NEW JERSEY

Engineer, machinist and electrician; position as engineer or setting up power plant machinery and appliances. Good references. Technical, 15 years' experience. Box 542, AM. MA.

NEW YORK

A superintendent or manager; good mechanic and executive. Box 511, AMERICAN MACH.

Superintendent machine shop and foundry. Mechanic, executive, hustler. Box 552, AM. MA.

Mechanical engineer, 28, graduate, wants position. New York City preferred. Box 543, AMERICAN MACHINIST.

First class draftsman, technical education, Corliss, high speed or gasolene engines, wants position. Box 548, AMERICAN MACHINIST.

First class machinist wants position as foreman. If you seek capable, energetic, ambitious young man, address Box 550, AMER. MACH.

Draftsman wishes a position, seven years' experience in automatic machinery, jigs, fixtures and tools; any location satisfactory. Box 544, AMERICAN MACHINIST.

Designer, 18 years' experience getting up and improving machine tools, special machinery, fixtures. Position desired as designer or assistant manager near New York City. Box 556, AMERICAN MACHINIST.

Designer, six years' varied experience, automatic machinery and experimental work; also three years' practical shop experience. Technical education. Best references. Box 545, AMERICAN MACHINIST.

Competent, capable mechanical draftsman with five years' experience along general lines. Technical graduate, accurate, quick worker, desires change at $18.00 to start. Box 513, AMERICAN MACHINIST.

Draftsman, with 14 years' shop and office experience, locomotive design, special work, systematic rearrangement of equipment in machine, boiler shops, etc., to reduce unapplied labor and increase output. Box 506, AM. MA.

Master mechanic with extensive and varied experience constructing and manufacturing in the States, Canada and South America, age 39, desires position where a responsible, high grade, broad gauge man is wanted. Box 507, AMERICAN MACHINIST.

Designer, 12 years' experience, shop, office and road with manufacturing machinery, can take entire charge of work from idea to output of finished articles. Technical education, speak French, travel anywhere, highest New York references. Box 546, AMERICAN MACH.

A-1 mechanic wishes to make a change. Experience in handling men, in building fine automatic machinery, interchangeable tools for all kinds of fine machine tools. In charge of present position nine years. Best of reference. Address Box 555, AMERICAN MACHINIST.

Position by a first class industrial teacher, now connected with one of the American technical schools. A thoroughly trained and practical man, who has a technical education and several years of successful teaching experience in up-to-date schools; capable as a teacher or executive and acquainted with industrial problems in the shop as well as the school. Box 538, AMERICAN MACHINIST.

OHIO

Noted machine tool designer, German, 31, unmarried, with technical graduation and several years' shop experience, who was four months in Europe to make special studies on gear hobbing machines, desires position as designer or chief draftsman. Hard and honest worker with first class reference. Box 540, AM. MACH.

PENNSYLVANIA

Expert cost accountant and systematizer desires an executive connection with manufacturing concern. Up-to-date methods and satisfactory results guaranteed. Box 304, AMERICAN MACHINIST.

A young and up-to-date mechanic, with 17 years' experience on tools, dies and experimental work; have also held position as inspector; would accept any position of trust. Box 547, AMERICAN MACHINIST.

## Help Wanted

*Classification indicates present address of advertiser, nothing else.*

ILLINOIS

Wanted—Mechanical superintendent for large plant in Chicago suburb. Must be good executive and systematizer, capable of handling 1000 men; one with gasolene and automobile engine experience preferred. State qualifications, salary wanted, full particulars. Excellent opportunity for right man. Box 520, AMERICAN MACHINIST.

INDIANA

Wanted—Six good lathe men and four good toolmakers, steady work on gasolene engines. Box 519, AMERICAN MACHINIST.

NEW JERSEY

Wanted—Competent draftsman familiar with printing machinery. Must be capable of designing. State fully age, experience, references and salary. Box 554, AMERICAN MACH.

NEW YORK

A high grade man to fill the position of mechanical superintendent. Must be a hustler. Address, stating references and salary expected, Box 529, AMERICAN MACHINIST.

Wanted—Brass foundry foreman, none but experienced man need apply; one familiar with the valve business preferred. In replying, state if now employed, age, wages expected. Box 521, AMERICAN MACHINIST.

Wanted—Experienced machine designer to take complete charge of drafting room of large manufacturing concern. Man with experience on automatic machinery and tools preferred. Address "B. B.," care AMERICAN MACHINIST.

Wanted—Young man as assistant foreman of woodworking shop. Must have knowledge of up-to-date woodworking practice and the economical cutting and handling of stock. Experience on wood patterns and mold boards desirable. Box 523, AMERICAN MACHINIST.

Wanted—A young man, expert in making time study for setting piecework rates. Must have tact and mechanical ability. The opportunity offered for making good is an excellent one for the right man. State age and experience. Box 537, AMERICAN MACHINIST.

Wanted—Young man with good general knowledge of machine tools, especially milling machines. Practical shop man, desiring advancement, preferred. Address "Opening," care AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—Mechanical draftsman, young man familiar with high speed steam engines. Excellent opportunity for the right party to work into leading position. To receive consideration give full details of experience, length of engagements, salary received, etc. Box 534, AM. MA.

Wanted—Machine teacher in trade school. Must be a first rate workman and have a fair general education, especially in mathematics and mechanical drawing, not over 40 years old, and abstainer from tobacco and alcoholic beverages. One who has been foreman or has had

some experience at teaching preferred. Address with full particulars and salary desired, Williamson School, Delaware County, Pa.

## For Sale

*Classification indicates present address of advertiser, nothing else.*

For sale, absolutely new, a No. 2½ heading machine and a No. 2½ reheading machine, Waterbury-Farrel make, never used. Ohlen Company, Box 740, Columbus, Ohio.

For Sale—Tracings, patterns, jigs and templets for the following size gas and gasolene engines: 1½, 3 and 5 horse-power vertical and 3, 5, 8, 10, 12, 16 and 20 horse-power horizontal; also a number of finished and unfinished engines of the above sizes. All of the above sizes have been in successful operation for several years. This is a splendid opportunity for anyone wishing to build gas or gasolene engines. You can save thousands of dollars in experimental work by purchasing this complete outfit. Shop rights of valuable patents on these engines will be given to purchaser. Box 366, AMERICAN MACHINIST.

For Sale—Safety friction clutch, ingenious design, connects automatically and disconnectable from a shield, very powerful and cheap to make. Box 539, AMERICAN MACHINIST.

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